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U. S. NAVAL TECHNICAL MISSION TO JAPAN
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RESTRICTED

From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Japanese Suicide Craft.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, covering Target S-02 of Fascicle S-1 of reference (a), is submitted herewith.

2. The investigation of the target and target report were accomplished by Comdr. R.H. Hedgecock, USN.

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Captain, USN

JAPANESE SUICIDE CRAFT

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE S-1, TARGET S-02

JANUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

SHIP AND RELATED TARGETS

JAPANESE SUICIDE CRAFT

Part I - SHINYO - "Special Attack Boats"

Only Type 1, Mod. 1, and Type 5 SHINYO boats were actually used as suicide special attack boats. Types 2, 3, 6, 7, and 8 were in design and experimental stages in an endeavor to attain better performance. Type 4 was never designated because of the superstition attached to "Shi", its Japanese pronunciation, which can also mean "death".

Type 1, Mod. 1, a 5.1 meter, single-man, single engine, 23 knot, inboard motor boat, carrying a 270kg explosive charge in the bow, was later supplemented with the Type 5, designed as a "division leader". Type 5 was a 6.5 meter, two-man, two-engine, 25 knot, inboard motor boat, carrying a 270kg explosive charge in the bow, and equipped with radio.

The conclusion of the war ended the production of the successfully tested Type 8, which was an 8.0 meter, three-man, three-engine, 23 knot, inboard motor boat, designed as a "squadron leader". This non-suicide SHINYO boat was built to lead several divisions of Type 1, Mod. 1 SHINYO, each division in turn to be led by a Type 5 SHINYO. The Type 8 was not equipped with a bow charge, but instead carried two special 28cm launchable torpedoes. The Type 8, like the Type 5, was equipped with radio.

Part II - KAITEN - "Human Torpedo" or "One Man Submarine"

A KAITEN was substantially an altered torpedo, having human control and additional fuel capacity inserted between the torpedo warhead and the torpedo engine.

Only KAITEN Types 1, 2, 4, 5, 6, and 10 were projected or built; the other numbered types were never designated.

KAITEN Type 1 was an altered Mark 93, Mod. 3 torpedo. Type 6 was distinguished by a modification of the forward air flask of Type 1. Type 2 was an unsuccessful version of a KAITEN built as such, and not altered from a torpedo. It was propelled by gases of combustion formed by hydrogen peroxide, hydrogen hydrate, fuel, and cooling water. Type 4 was an unsuccessful attempt to operate the Type 2 KAITEN on conventional Japanese torpedo fuel, namely, kerosene and oxygen. Unsuccessful Type 5 merely contained a modification of the forward air flask of Type 4. Type 10 was a successful adaptation of the Mark 92 electric torpedo, but was perfected too late for mass production.

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REFERENCES

Location of Target:

SHINYO - Fourth Section (Ship Construction) of the Navy Technical Department, TOKYO.
KAITEN - Second Section (Torpedo) of the Navy Technical Department, TOKYO.

Japanese Personnel Who Assisted in Gathering Documents and Who Were Interviewed:

For SHINYO and KAITEN:

A. KATAYAMA, Constructor Admiral, IJN.
K. YADA, Constructor Captain, IJN.

For SHINYO Only:

S. MAKINO, Constructor Captain, IJN, director of SHINYO Boat Design from its beginning.
T. KOYAMA, Civilian Engineer in the Fourth Section, Navy Technical Department, who had worked on design of small boats since 1934. He supervised drafting work for the SHINYO Boat hulls designed by the Navy Ministry.
K. MATSUSHITA, Ordnance Lt. Comdr., IJN, designed the Power Rocket "4FH120".

For KAITEN Only:

K. MIMIZUKA, Ordnance Captain, IJN, directed KAITEN design from its beginning.
R. NAGANO, Engineering Lt. Comdr., IJN, designed the No. 6 Engine from the Type 2 and 4 KAITEN. In 1938 he studied internal combustion engines for one year at the Technical College in Dresden, Germany.

Related Report:

NavTechJap Report, "Japanese Torpedoes and Tubes, Article 1 - Ship and KAITEN Types", Index No. O-01-1. (Contains complete data on KAITEN).

INTRODUCTION

This report covers SHINYO Boat "Special Attack Craft", and KAITEN Human Torpedoes or "One Man Submarines".

Midget submarines were omitted from this report because both two-man and five-man submarines launched their torpedoes and returned for reloads. Midget submarines were covered in NavTechJap Reports, "Characteristics of Japanese Naval Vessels, Articles 6 and 7 - Submarines - Supplements I and II", Index Nos. S-01-6 and S-01-7, respectively.

S. MAKINO designed the SHINYO Boats for the Navy Ministry. Though a constructor captain, he contributed to the design features of the RO gas jet engine for Type 6 SHINYO.

K. MIMIZUKA designed the KAITEN for the Navy Ministry.

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THE REPORT

PART I
SHINYO "SPECIAL ATTACK BOAT"

A. General. SHINYO, applied to Japanese naval craft, signified a small boat which utilized the explosive charge carried in its bow by ramming the side of the intended victim.

SHINYO boats were manned by middle school boys about 15 to 16 years old. It is reported that an ample supply of volunteer pilots was obtained because of the special privileges, early responsibility, fast promotion, and the promise of a posthumous monetary reward to the volunteer's parents.

SHINYO boats were collected in special attack basins along the coast, carried on mother ships, and even stored in bomb-proof cases equipped with dollies and tracks for launching. Plans for CV JUNYO were discovered which showed the flight deck and both hangar decks completely covered with SHINYO boats. Special booms lifted off two SHINYO boats at a time and special fenders separated them while being lowered. It seems probable that the Japanese intended to transport a large number of SHINYO at one time to another base and that they did not intend to fight an engagement with the JUNYO-SHINYO combination.

The SHINYO attack procedure was to crash the side of the target. The rudder could be lashed, allowing the pilot to jump overboard just before impact, though it was expected that each pilot would make sure of a good hit by riding his craft to a glorious death.

The only two types of SHINYO used were relatively slow, 23 and 25 knots; hence the SHINYO program involved a constant struggle to develop an extra high speed boat for efficient daylight strikes.

> (Note: One BAKA bomb suicide pilot reported that 50 youths were lined up and a request made for eight to volunteer. All held up their hands. The pilot interviewed stated that he held up his hand but did not want to be selected. He became one of the eight "volunteers".)

B. Type 3 SHINYO Boat. The elementary conception of a SHINYO boat was a small, one-man attack boat driven by an outboard motor and carrying an explosive charge in its bow. Because no suitable outboard motors were ready for mass production, it was necessary to design an inboard motor, using an available automobile engine. The project of an outboard motor carried through the program only as an idea, with the number designation "Type 3", but no actual design work was ever accomplished. All other SHINYO type numbers were inboard motor boat designs.

C. Type 1 SHINYO Boat. Around 1937, the Japanese hull designers started a program of studying hull shapes based on existing British, Italian and American motor and torpedo boats. Many models were made and towed. [See NavTechJap Report, "Japanese Model Basins", Index No. S-83(N). Sixty models of round, vee, and single step were tested. Many recorded data in the Japanese Director's notebook, including some SHINYO boat lines, were forwarded to the Taylor Model Basin with NavTechJap Document Numbers ND50-1291, ND50-1292, and ND50-1293.]

By 1941 the Japanese had six 18-meter motor torpedo boats of their own design. These models were put into mass production at the beginning of the war.

When the SHINYO boat program was started in March 1944, the models towed were copied from the existing 18-meter torpedo boat. Because at full speed the MTB planed with only its stern area a wetted surface, and it was intended to run the SHINYO always at full speed, the lines of the 18-meter MTB were diminished by a factor of about 2.2. Then about two meters of that part of the bow which was unwetted at full speed were cut off and the new stem faired in sharply to the scaled lines. This produced the 6-meter Type 1 SHINYO. (See Figure 1 and Table I for detailed dimensions).

Of this Type 1 SHINYO, six steel ones were built at YOKOSUKA and two wooden ones at TSURUMI, near YOKOHAMA. The first boat was tested on Japanese Navy Day, 27 May 1944. It appeared that the bow would have to be redesigned, because the boat took too much water over the bow at low speeds. At the same time it was found that the gear box could not be mass produced. Still another difficulty was encountered in the steel models: a wrinkling of the thin bow plating. Since it would have taken six months to make "auto body type" presses at a time when steel and steel workers were at a premium, further redesigning of the steel model was abandoned and subsequent models were of wood construction.

D. Type 1, Mod. 1 SHINYO Boat (Figure 2). This boat, first tested in July 1944, was designed for the purpose of eliminating the difficulty with the bow and the inability to turn out the gear boxes by mass production.

1. To eliminate the gear box, the engine was turned around to permit the use of a direct drive. This resulted in the engine being further forward in the boat. For balance, the bow explosive charge was moved further aft and about 25 to 50kg of ballast was added in the stern.

2. Moving the bow charge further aft permitted the bow of the new Type 1, Mod. 1 to be shortened, resulting in an overall boat length of 5.1 meters. The new stern was faired into the existing lines with a bow having more flare than Type 1.

The cockpit contained the steering wheel, magnetic compass, engine controls, and controls for the bow explosive charge.
This Type 1, Mod. 1, powered by a standard Toyoda KC 6-cylinder automobile engine, made its designed speed of 23 knots (see Table I for performance data, range, fuel, etc.). From information obtained from a Type 1, Mod. 1 SHINYO recovered on Corregidor, Mobile Explosives Investigation Unit No. 1 prepared a report, R140 (PWA - wec) "Japanese Suicide Boats", which describes the explosive charge and firing circuit on these boats. The bow explosive charge consisted of 270kg of Type 98 explosive. On the rear of the charge container were two Type 93 mine boosters. One of the boosters contained an electric detonator; the other, with a non-electric detonator, had a pull-type firing device. The charge could be fired by three methods: (1) electrically on impact, (2) electrically by closing a manual switch, and (3) by pulling the pull igniter. For the bow contact switch, a steel strip with several "spikes" on it was separated from another steel plate by a rubber strip. Bow impact would force the spikes through the rubber, close the electric circuit, and fire the charge, provided the safety switch was properly positioned. The operator had to pull a "safety peg" before he could ignite the charge by the pull igniter. The operator had a cockpit switchboard on which were located a battery switch, a manual switch, a safety switch, and a selector switch. The knife switch put the battery in the circuit. The safety switch cut only the bow contact switch in and out of the circuit. The selector switch at position "0" isolated the manual switch from the detonator, but the charge could still be fired by the bow contact and the safety switch. The selector at "1" tested the battery voltage with a small light. The selector at "2" put the bow contact switch in the test circuit, but not its detonator or the manual firing switch. Position "3" put the manual firing switch in the circuit, and, if the safety switch was closed, the charge could be

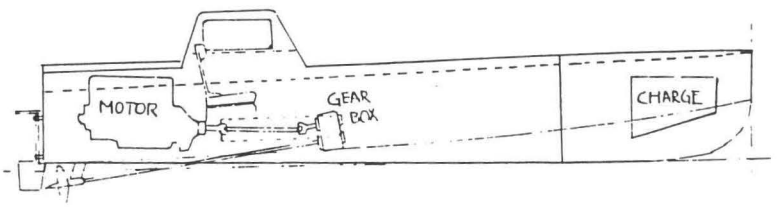
TABLE I

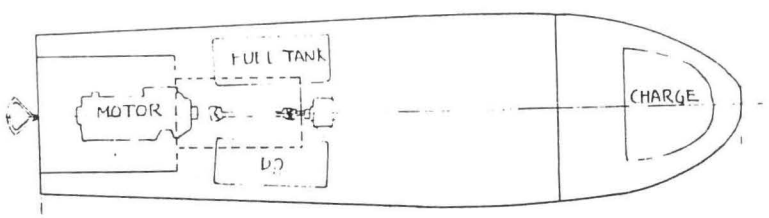
SUMMARY OF SHINYO BOAT DATA, ALL TYPES

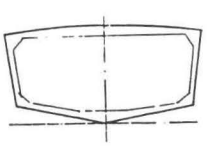
Type	Hull	Length (m)	Breadth (m)	Depth (m)	Draft (m)	Displacement (tons)	Power	B.H.P. and R.P.M.	Speed (knots)	Radius of Action Kt - Sea Mile	Fuel Capacity	Propeller Dia x Pitch	E.H.P. Speed - EHP	Armament
1	Steel or Wood V-Bottom	6.0	1.65	0.8	0.6	1.35	Toyoda or Nissan Automobile Engine	70 - 2800 / 2210	23 - D&A	20 - 250	140 (2x70)	3 Blade 320 x 465		Charge 1 Wt.270kg Rocket 2x12cm
	Wood V-Bottom	5.1	1.65	0.8	0.6	1.40		67 - 2600	23 - D&A	20 - 250	140 (2x70)	290 x 360	26.4 - 30.2	
2	Wood Hydrofoil	6.0	2.40 (0.9)	0.8	0.9	1.2	Toyoda KC 6cyl. Auto Engine	67 - 2600	30 - D 18 - A					
3							Outboard Motor			"				
5	Wood V-Bottom	6.5	1.860	0.9	0.6	2.4	Toyoda KC 6cyl. Auto Engine	134 (2x67) 67 - 2600	25 - A 28 - D	22 - 275	280 (4x70)	3 Blade 280 x 390 M B	28 - 58	Charge 1 Wt.270kg Rocket 2x12cm Wireless Tel. MG 1x13mm
6	Wood V-Bottom	5.1	1.65	0.8		2.0	"RO" Type Gas Rocket	Time 100sec	50 - A 70 - D	3,000m				
	Wood Single-Step	7.0	1.8	0.8	0.5	2.5		Thrust 800kg	70 - A 100 - D	4,500m				
7	Steel Single-Step	7.0	2.2	0.8	0.6	2.15	Powder Rocket	Time 9sec No. 10 Thrust 800kg	70 - D 60 - A	3,000m				
8	Wood V-Bottom	8.0	2.3	1.05	0.6	4.0	Toyoda KC 6cyl. Auto Engine	201 (3x67) 67 - 2600	22 - D 23 - A	20 - 350	600 (3x200)	3 Blade 290 x 360 M B		Torpedo 2 - 28cm Rocket 2x12cm Wireless Tel.

Legend: D - Designed speed. A - Actual speed.

Note: Type No. 4 was omitted.

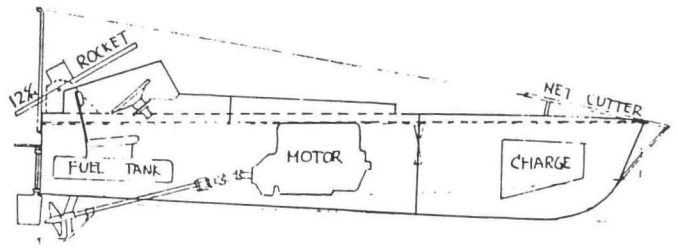


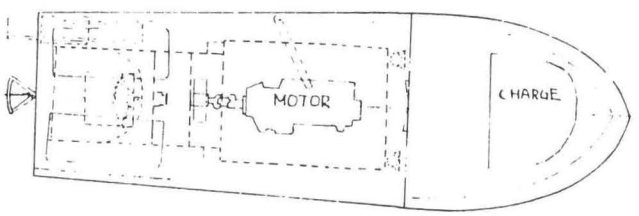


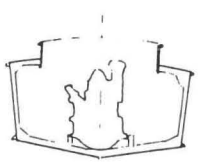


LENGTH	6	metre
DISPLACEMENT	1.35	tons
B.H.P	70	
SPEED	2.3	knots
RADIUS OF ACTION	250	S.M
CREW	1	

Figure 1
SHINYO TYPE 1







LENGTH	5.1 metre
DISPLACEMENT	1.4 tons
B.H.P	67
SPEED	23 knots
FUEL	140 Litre
RADIUS OF ACTION	250 s.m.
MACHINE GUN	
ROCKET	2×12⅝m
CREW	1

Figure 2
SHINYO TYPE 1 MODEL 1

fired either by bow impact or by the manual electric switch.

The Type 1, Mod. 1 SHINYO was equipped with a net cutter extending from the bow to a raised stanchion on the stern. It also had two 12cm rockets mounted on two primitive wood launching troughs on either quarter, to be fired against enemy attacking boats, attacking airplanes, or the intended victim, and to serve as a morale booster.

E. Type 2 SHINYO Boat (Figure 3). Early in the SHINYO program in March 1944, when the first model of the Type 1 SHINYO scaled from an 18-meter MTB was being made, the first model of the Type 2 "hydrofoil design" was constructed (Figure 3). This alternate project to secure a high-speed inboard motor boat was drawn up by Y. OTSU, a civilian engineer working at the Naval Research Institute. The hull of this 6.0-meter wood boat was built at the Yokohama Yacht Works. The hydrofoil assembly was built at the Yokosuka Navy Yard and brought to the Yokohama Yacht Works for assembly. Powered by the standard 67hp Toyoda automobile engine, the first boat was ready for test about August 1944. The Type 2, difficult to design and build, performed unsatisfactorily at its trial and showed lack of balance in the running condition. Designed for 30 knots, the hydrofoil design presented large resistance in the running test and was only able to attain a maximum speed of about 18 knots. This design was abandoned.

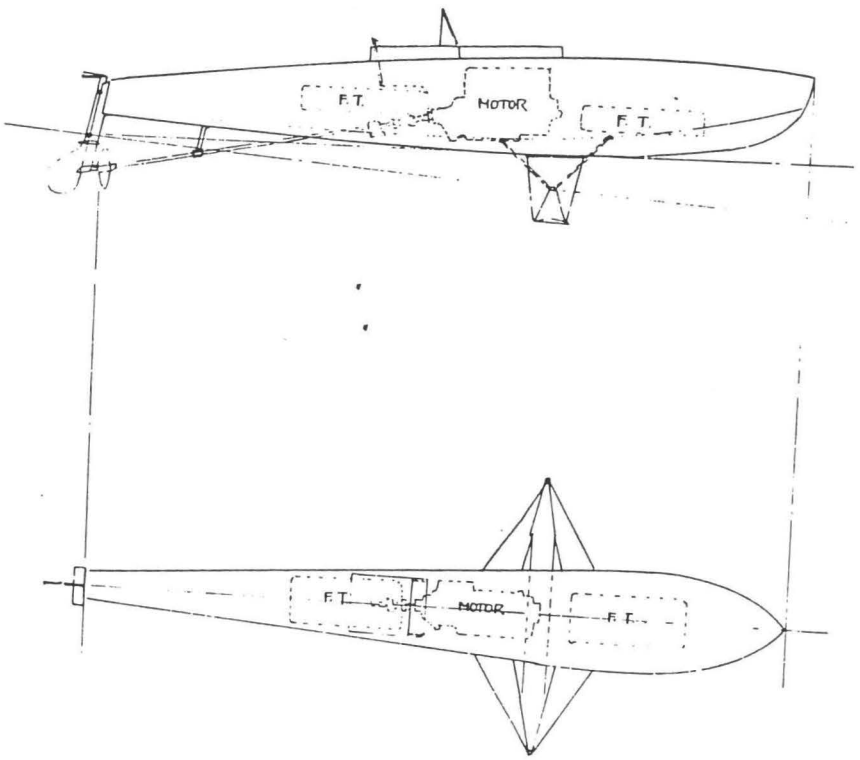
F. Type 5 SHINYO Boat (Figure 4). Since a "division leader" boat for the Type 1, Mod. 1 SHINYO was needed, the two-engine, two-man, Type 5 SHINYO was conceived. The lines of the Type 5, immersed at high speed like the Type 1 and the Type 1, Mod. 1, were similar to the 18-meter MTB of 1941. The first model was towed in about August 1944 and the first running test was made in September 1944. Designed for about 28 knots and powered with two standard Toyoda automobile engines, the Type 5 made 25 knots on trial. It was accepted and put into production.

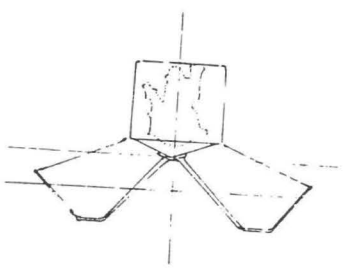
This boat had the same bow explosive charge as the Type 1, Mod. 1, and the same two stern 12cm rockets. It carried a crew of two men. Radio equipment was installed to assist the boat in its "division leader" duties. The net cutter was an improved version of the kind used on Type 1, Mod. 1 SHINYO. One 13mm machine gun was added just forward of the cockpit for increased protection, fire power, and morale.

G. Type 6 SHINYO Boat. The previous SHINYO models had at best done 25 knots, which was considered insufficient for daylight attacks. The Type 6 was an effort to adopt "jet propulsion" to replace the automobile engine as motive power, because the automobile engine represented considerable weight for its delivered horsepower. The first test was made about October 1944 by Mitsubishi Shipyard at NAGASAKI.

The hull of this first Type 6 was the same as that of the Type 1, Mod. 1 SHINYO, but reinforced along the bottom. The idea for the engine was borrowed from the torpedo designers' efforts to run the Type 93 torpedo and the Type 2 KAITEN (human torpedo) on gases of combustion formed by hydrogen peroxide, hydrogen hydrate, kerosene and cooling water (see Enclosure (A) on the Type 2 KAITEN, "The New Energy Source of the Torpedo".).

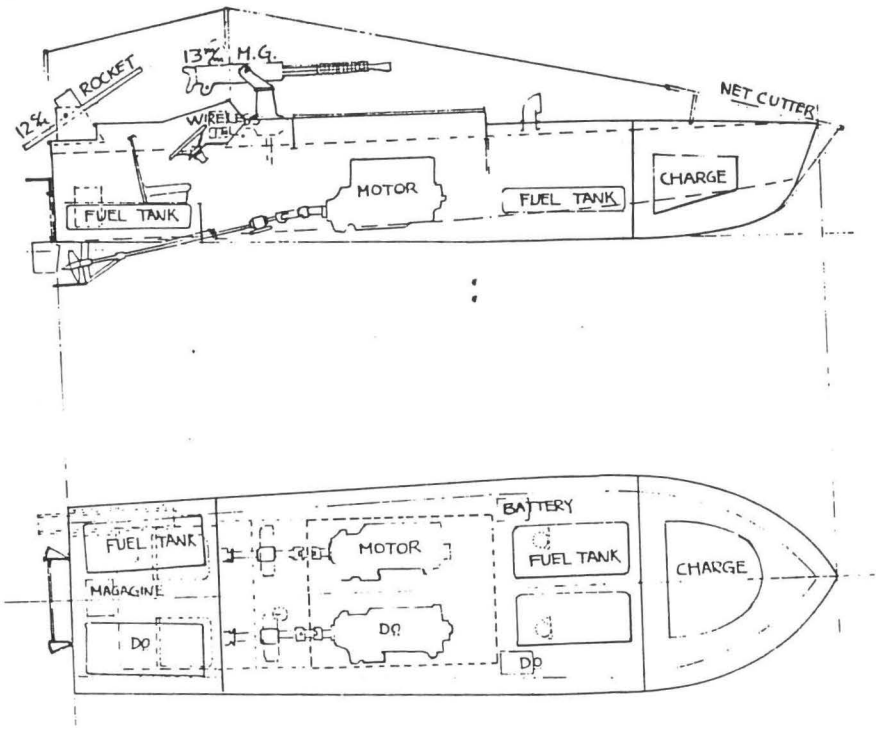
The RO gas engine, Type 1, used in the SHINYO Type 6, had an arrangement very similar to the RO gas engine, Type 2, used in the SHINYO Type 6, Mod. 1 (see Figure 5) except that the RO Type 1 did not have external water cooling of the combustion chamber. This RO gas engine, Type 1, consisted of an air tank carrying air at 150kg/sqcm, which through reducing valves, applied 16kg/sqcm pressure to a hydrogen peroxide tank, a hydrogen hydrate tank, and a kerosene fuel tank, (see Figure 5); a combustion chamber (see Figure 6); twelve hydrogen-peroxide hydrate spray nozzles (see Figure 15). (For their arrangement on the combustion chamber and the eight fuel nozzles, see Figure 6).

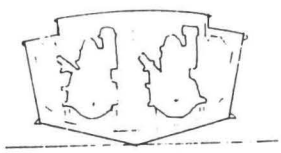




LENGTH	6	metre
DISPLACEMENT	1.2	tons
B.H.P	67	
SPEED	30	knots
CREW	1	

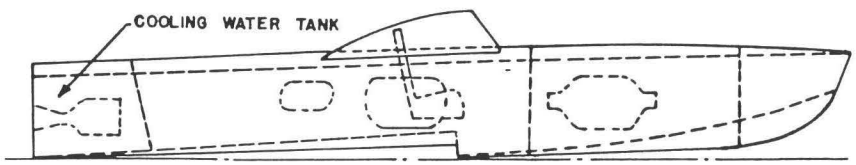
Figure 3
SHINYO TYPE 2



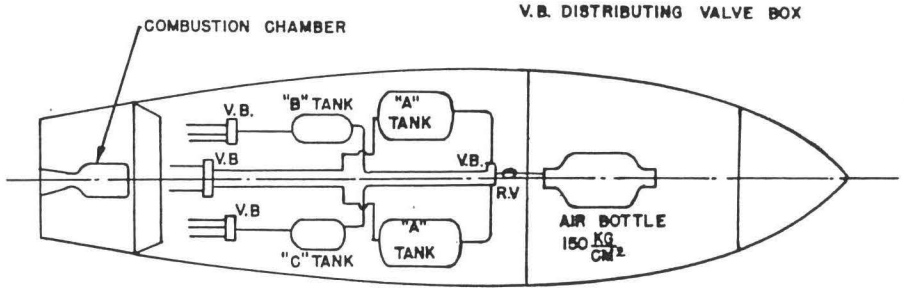


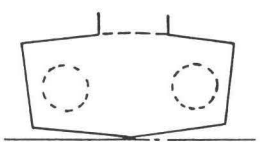
LENGTH	6.5 metre
DISPLACEMENT	2.4 tons
B.H.P	134
SPEED	25 Knots
FUEL	280 Litre
RADIUS OF ACTION	275 s.m.
MACHINE GAN	1×13㎜
ROCKET	2×12㎝
CREW	2

Figure 4
SHINYO TYPE 5



"A" TANK HYDROGEN PEROXIDE
"B" TANK HYDROGEN HYBRATE
"C" TANK PETROLEUM
R.V. REDUCING VALVE TO 18 $\frac{KG}{CM^2}$ FROM 150 $\frac{KG}{CM^2}$
V.B. DISTRIBUTING VALVE BOX





LENGTH — 7 METERS
DISPLACEMENT — 2.5 TONS
POWER — "RO" ROCKET
SPEED — 70 KNOTS
RADIUS OF ACTION — 3500 METERS
ABT- 100 SECS.
CREW — 1

Figure 5
SHINYO TYPE 6 MODEL 1

The combustion chamber (see Figure 6), operating at 12 kg/sqcm differed in principle from that of the hydrogen peroxide torpedo combustion chamber (see Figure 14), in that it did not have internal cooling water. The torpedo combustion chamber was vertical and the generated steam formed uniformly around the sides. The RO gas engine combustion chamber was horizontal and it had been reported by its designer (atomic bomb victim) that the steam would concentrate in the bottom and would not flow along the top of the chamber. Because no cooling water was used, about twice the ratio of fuel to hydrogen-hydrate was consumed as when cooling water was used (see page 29). Figure 6 shows the arrangement of the twelve hydrogen peroxide-hydrogen hydrate nozzles and eight fuel nozzles. The numbers "1", "2", and "3" indicate the sequence in which they were cut in to increase speed. A very complicated individual nozzle piping arrangement was installed on the first RO engine, using tin-lined copper pipe for the hydrogen peroxide.

In the first test of the SHINYO Type 6, the boat reached 50 knots prior to the overheating of the combustion chamber and leakage of gas piping, which resulted in a fire, causing it to burn and sink.

In Table I the range is listed as 3000 meters and time of running 100 seconds. The designer could not obtain 120 seconds and 3500 meters because of the weight of fuel carried. The amount of hydrogen peroxide used was about ten times by weight that of the hydrogen hydrate. To produce a push of 750kg over a period of 120 seconds would have required a total weight of hydrogen peroxide, hydrogen hydrate, and kerosene of about 900kg. The ton of fuel represented about one half of the initial total weight of the boat.

The combustion chamber and nozzle system weight was very small, estimated in the absence of accurate blue prints to be 50 to 75kg.

H. Type 6, Mod. 1 and 2 SHINYO Boat. The next attempt at RO gas propulsion was made with the Type 6, Mod. 1 about December 1944. MITSUBISHI designed the new 7.0-meter, wood, flat bottom, step-type boat shown in Figure 5.

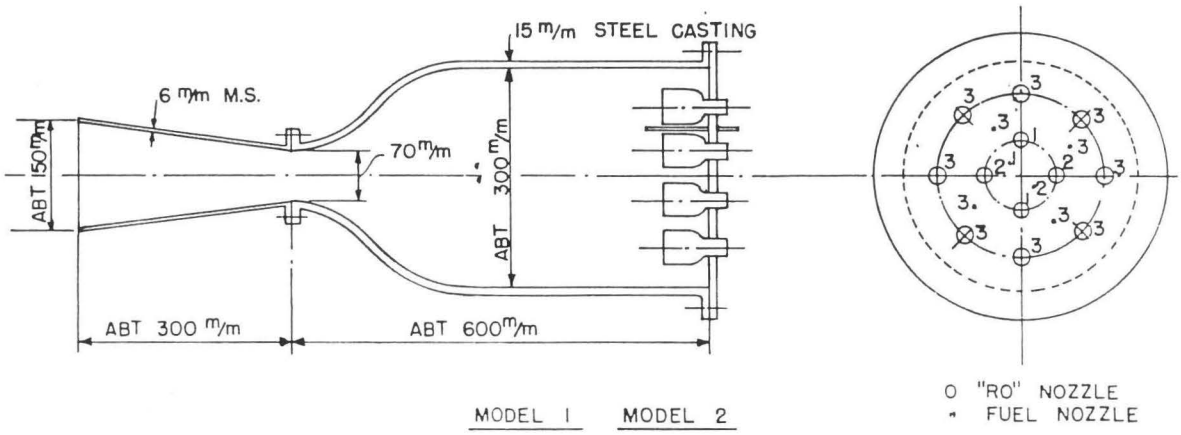
Because each hydrogen-peroxide nozzle in the RO Type 1 produced about 100kg push, it was decided that Type 6 had been much over-powered and that the RO Type 2 engine to be used in the Type 6, Mod. 1 SHINYO would have only eight hydrogen-peroxide nozzles and six fuel nozzles (Figure 6). The combustion chamber was reduced in size and surrounded by cooling water. A cast head manifold for the new combustion chamber made it possible to control the three power settings with three pipes of each fuel material entering the chamber instead of a great number of individual pipes. The hydrogen-peroxide piping was changed to duraluminum, with outer spaced copper sleeves used only for protection.

Here again, in the Type 6, Mod. 1 as in the Type 6, the total weight of fuel was a considerable factor. About one half of the initial starting weight of the boat was represented by fuel weight. It was hoped that the 750 to 800kg push for 120 seconds would produce a range of about 4500 meters at a speed approaching 100 knots.

The Type 6, Mod. 1 was designed for 100 knots. On the trial run, at about 70 knots the boat porpoised very badly on the small waves, turned over, and severely damaged the side of the hull.

MITSUBISHI built another new hull having a deep vee bottom with short air wings, but it too failed to keep its balance at higher speeds (Type 6. Mod. 2). S. MAKINO*, director of the SHINYO program, felt the RO gas Type 2 engine was

*S. MAKINO stated that he had consulted with the aviation designers concerning RO gas propulsion and that during the summer of 1945 he had expected to hear that the SHUSHI fighter would be successfully attacking our B-29s. This heavily machine-gunned fighter was supposed to have ascended during her time of power flight of about 3 minutes to 10,000 meters and made a firing run on our bombers.



	MODEL 1	MODEL 2
NUMBER OF "RO" NOZZLE	12	8
NUMBER OF FUEL NOZZLE	8	6
WATER INJECTION	EXISTANT	NON-EXISTANT
	NOT USED	

Figure 6
COMBUSTION CHAMBER OF "RO GAS JET ENGINE"

11-38

the solution to a means for obtaining high power for short periods of time. His next suggestion was to attach a high monoplane wing about four meters in length with a chord of about one meter, fitted with ailerons, so that the pilot could level the boat transversely like an airplane. The Navy line officers decided that the high speed of such a small boat was too dangerous to control, and complex control features would require too much training for the youthful suicide pilots: hence, all Type 6 designs were abandoned.

I. Type 7 SHINYO (Figure 7). Yokosuka Navy Yard has been working on a rocket-propelled Type 7 boat at the same time that MITSUBISHI was working on the Type 6 jet-propelled boat. The Type 7 used the same reinforced steel, seven-meter, single-step hull that the Japanese motor torpedo chaser boat used at their torpedo firing range to retrieve test firings (Figure 7).

Ten powder rockets were installed in the stern as shown in Figure 7. These powder rockets (Figure 8) were the same type as those used to drive BAKA bombs. Each powder rocket burned for 10 seconds and gave a mean push of 800kg. S. MAKINO had started work on an automatic switch arrangement to ignite the rockets in turn, but the first and only test boat went out for her test in February 1945 with ten rocket switch hand push buttons.

With a designed speed of 70 knots and ten rockets for propulsion, it was anticipated that the Type 7 would reach her minimum designed range of 3500 meters. On the trial run, the operator had just pushed the third button when the boat, traveling at an estimated 60 knots, pushed its bow under a wave. The damaged Type 7 was given up along with the Type 6, since the Japanese naval line officers considered it too dangerous.

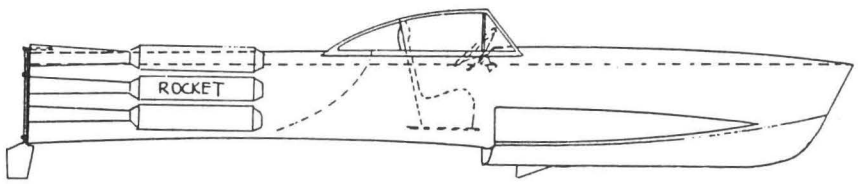
J. Type 8 SHINYO (Figure 9). The Type 8 was successfully tested by June 1945. Six experimental boats were used.

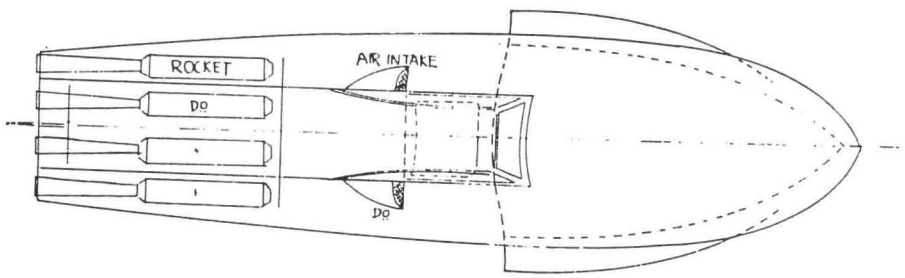
This type was a proportional enlargement of the Type 5, namely an 8.0-meter, three-engine, three-man, 23 knot, squadron leader designed to direct several divisions of Type 1, Mod. 1 SHINYO. Each division in turn was directed by one Type 5 SHINYO. Powered by three standard Toyoda automobile engines (Figure 9), the Type 8 bettered her designed speed of 22 knots by a margin of one knot.

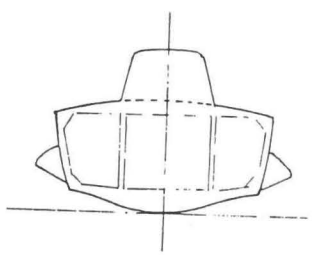
The Type 8 carried both portable communications and the powerful airplane radio-telephone.
The Type 8 was not a suicide craft with a bow explosive charge. Instead she was to carry two newly designed 28cm, 20-knot, 1500-meter, Type 5 torpedoes. These special torpedoes were to be simplified Type 2 torpedoes and were to have been in mass production by October 1945. Her other armament consisted of two 12cm rockets mounted on the stern as in the previous models.

K. Miscellaneous SHINYO Designs. Lt. Comdr. NAKAJIMA, of the Technical Research Institute, designed a 200kg, four-meter, pilotless, explosive-laden crash boat. It had a single stern powder rocket which exerted a 400kg push for 10 seconds, designed to drive the craft at 100 knots. On the trial run this boat porpoised several times, shot up into the air, revolved twice, and then dove into the sea. NAKAJIMA then started working on a design to give only 200kg push over a longer period of 40 seconds, but did not bring this to a successful completion.

NavTechJap Report, "Japanese Infra-Red Devices, Article 1 - Control for Guided Missiles", Index No. X-02-1, contains information on a proposed "heat-seeking infra red" automatic pilot. This device was to receive more heat radiation from the intended target than from the target's surrounding background. It was proposed that the SHINYO pilot would deliver his boat to the vicinity of the target, set the automatic "heat seeking" pilot, and then save himself from a suicide crash by jumping overboard. This device never materialized as a "SHINYO automatic pilot" because the target ship did not present sufficient "heat differential" as compared to its background.

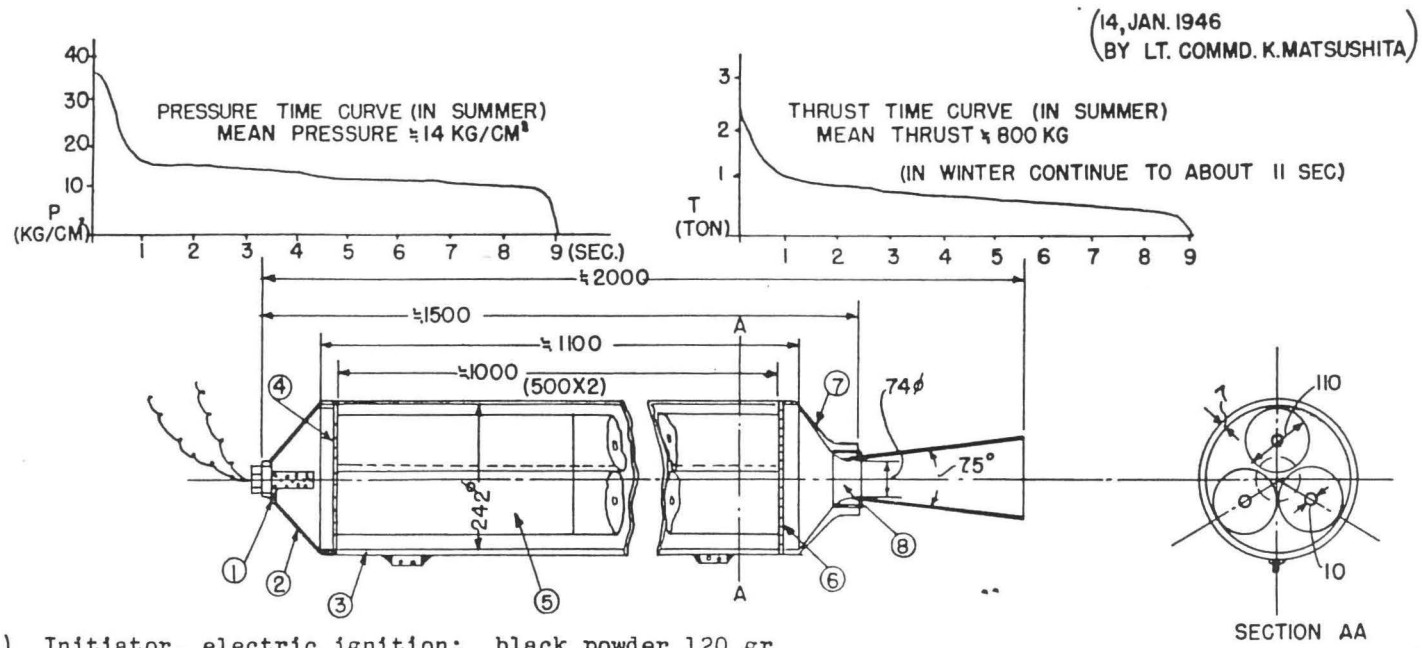






LENGTH	7 metre
DISPLACEMENT	2.15 tons
POWER	10-ROCKET
SPEED	70 knots
RADIUS OF ACTION	3,000 metre
CREW	1

Figure 7
SHINYO TYPE 7



(1) Initiator, electric ignition: black powder 120 gr
(2) Front cover of the combustion chamber
(3) Cylinder, forming the combustion chamber
(4) Front plate for fixing explosives, with many holes
(5) Propellant, (explosive "Toku FDT_6", No. 500)
(6) End plate for fixing explosives, with many holes
(7) End cover of the combustion chamber
(8) Convergent and divergent nozzle, area ratio: about 4.5 (this design is bad) (best value = 2.2 for this pressure)
(9) About 40 kg of explosive
(10) Total weight about 70 kg

Figure 8

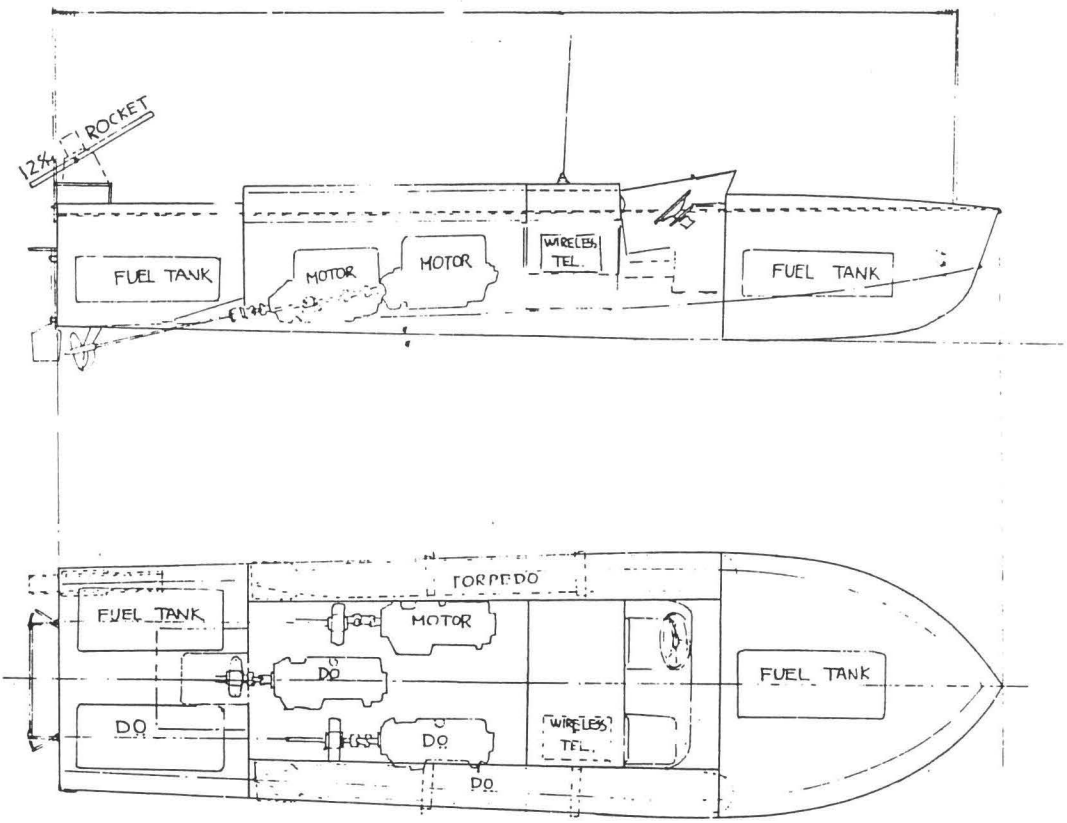
GENERAL VIEW OF THE POWDER ROCKET "4FH120"

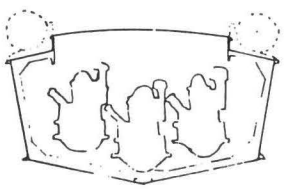
Composition of the propellant "Toku FDT_6"

(approx. value) MC 59% MNN 7%
NG 27% KS 3%
CL 4%

$$\overline{W} = 1.55 + 0.082P$$

$\overline{W}$: combustion velocity mm/sec (experimental data)
P: combustion pressure kg/cm²





LENGTH	8.0 metre
DISPLACEMENT	4.0 tons
B.H.P	201
SPEED	22 knots
FUEL	600 Litre
RADIUS OF ACTION	350 s.m.
TORPEDO	2
ROCKET	2×12cm
CREW	3

Figure 9
SHINYO TYPE 8

NavTechJap Report, "Japanese Infra-Red Devices, Article 3 - Research, Development, and Manufacture of Infra-Red Equipment", Index No. X-02-3, gives information on night direction of the SHINYO boats "on a beam" from a hilltop control station. This method, similar to airline flying on a beam, made use of dash-board signal lights, instead of the audible "dash-dot" signals used by air-lines, to indicate when the SHINYO was on the course. It was hoped that this might compensate for the poor visibility caused by the pilot position so close to the water. The project presented many "bugs" which were never completely ironed out.

PART II
KAITEN - "HUMAN TORPEDO" OR "ONE-MAN SUBMARINE"

A. General. KAITEN, applied to Japanese naval craft, signified a long range torpedo "which hits the enemy ship without fail due to the steering by the pilot who gets into the torpedo".

KAITEN were manned by 18 to 20 year old youths who, after about three months training, became ensigns. As in the case of the SHINYO boats, "volunteers" were reported to be plentiful because of fast promotion, special privileges, and the promise that their family would receive about ¥ 10,000 as a posthumous award. No doubt, many of the pilots were in no position not to volunteer.

In the initial phases of training, the volunteers were required to pilot SHINYO boats entirely by periscope and magnetic compass.

Six KAITEN were carried on top of I-class submarines. Tubes from the mother-sub to the lower hatch of the KAITEN and remote release equipment from the mother-sub allowed the KAITEN pilots to man their craft and start on their journey without the mother-sub having to surface. KAITEN were also transported on various "landing transporting craft". Bomb-proof KAITEN caves were being constructed along the invasion coasts of KYUSHU and HONSHU, wherever possible facing into a harbor or bay away from the sea. One or two KAITEN were located in each cave, resting on launching dollies which, in turn, were supported by rails extending to the water's edge.

Standard KAITEN attack approach procedure was to run about one meter below the surface of the water, take an occasional look with a retractable periscope, and dive to about five meters prior to striking.

B. Type 1 KAITEN (Figure 10). The KAITEN program had its inception in March 1944 and by August 1944, the successful Type 1 KAITEN was in production. The Type 1 utilized the Type 93, Mod. 3 torpedo (Figure 10). The warhead was enlarged to carry 1550kg of explosive, which could be detonated by the Type 2 inertia-type pistol (Figure 24), or by an electric mine fuse controlled from the pilot chamber (Figure 25). Inserted between the warhead and the torpedo engine compartment were the forward compartment, the control compartment, and the after main body. The forward body contained the air flask (A), the steering air chambers (D), and the forward trimming tank (E). The Type 93 torpedo was inserted into the after main body over the rear trimming tank (F). The center control chamber contained: a hand operated retractable periscope with a vertical movement of 70cm; an upper hatch (G); a lower hatch (H), used for a KAITEN pilot to enter his craft from an I-class mother-sub through a short tube while the mother-sub was submerged; batteries under the pilot's seat to run the electric gyro through a small A.C. motor generator set; hand directional steering; depth control; controls for starting, speed, and direction; safety release for the impulse firing pistol; and the firing key for the electric fuze. The engine section was similar to the Type 93, Mod. 1 torpedo, having enlarged vertical and horizontal fins (K_1) and (K_2) and enlarged vertical and horizontal automatic control rudders (M_1) and (M_2). The hand vertical rudder (L), was in the vertical fin (K_1).

Oxygen emitting sodium peroxide was carried for purifying the air in the pilot's chamber.

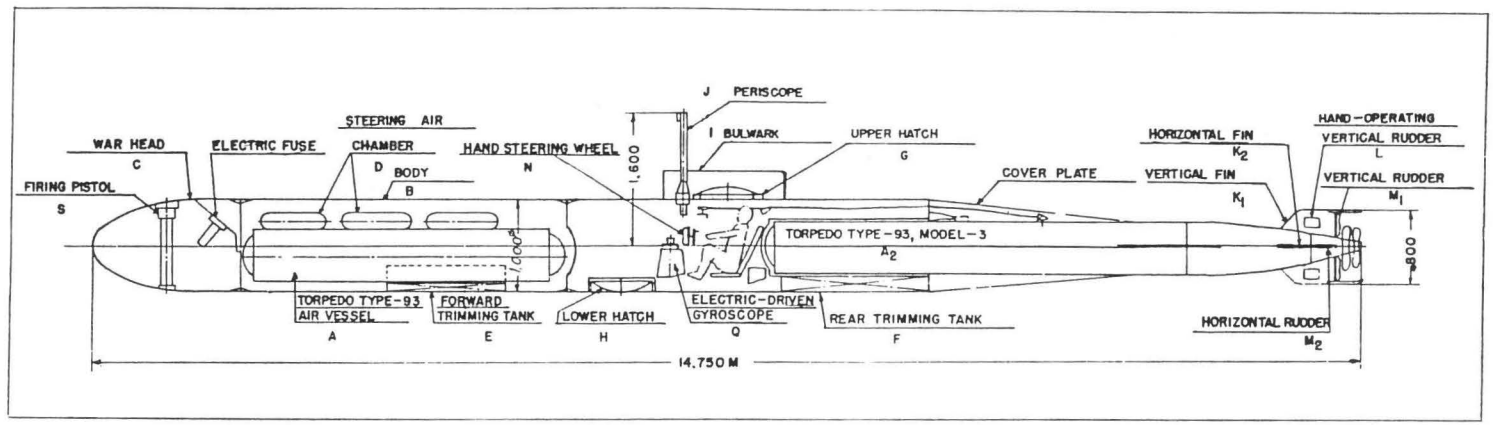


Figure 10

KAITEN TYPE 1

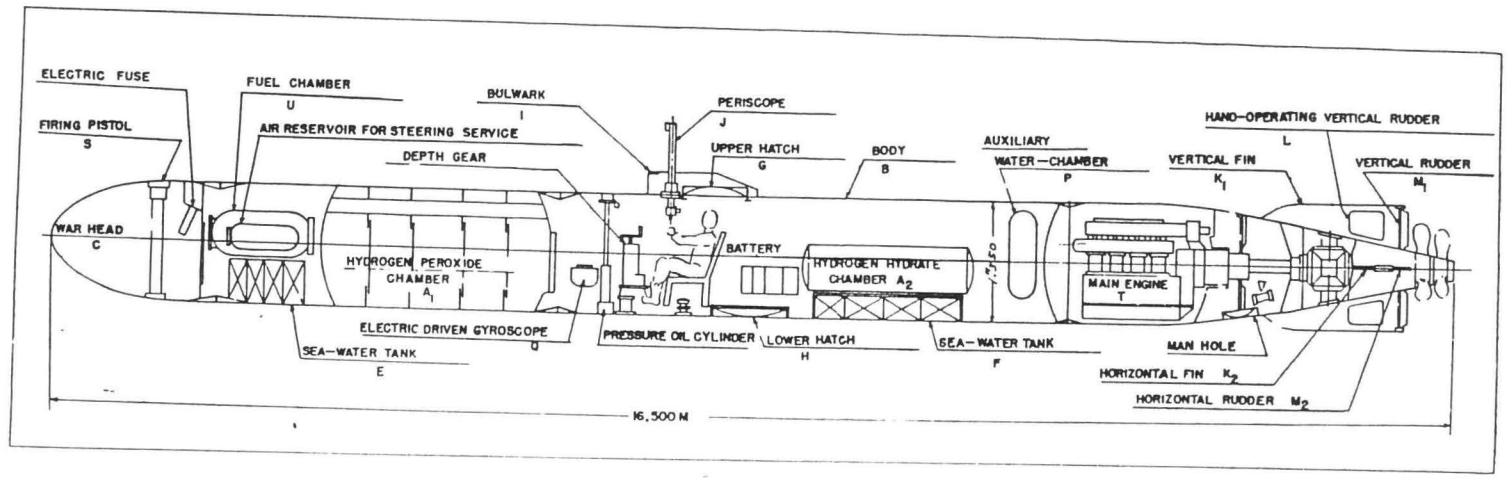


Figure 11

KAITEN TYPE 2

Speed, range, and other important characteristics are listed in Table II.

Since the KAITEN was designed to have a much longer range than the Type 93 torpedo, the air-driven Type 93 torpedo gyro was replaced by an electrically driven gyro (Figure 20 and Table III) located in front of the pilot. The current for the gyro was supplied by a 3-phase A.C. motor generator set, which, in turn, was driven by storage batteries. The pilot could steer by hand or set his course on the gyro pilot. Steering air from chambers (D) operated the vertical rudder to put the KAITEN on the course set on the gyro pilot. Depth was maintained by the balance of a spring setting against seawater pressure. Steering air from chamber (D) operated the horizontal rudders to keep the KAITEN at the determined depth of zero to 35 meters. Sensitivity of the depth mechanism was reported to be 50cm. During the last part of the run, the pilot increased the depth of run to about five meters. The trimming tanks were adjusted prior to loading the KAITEN on the mother-sub and were not adjusted during the run.

Though designed for a 100-meter test depth, the Type 1 leaked at this depth, but successfully withstood a 60-meter test depth.

The KAITEN was of variable speed, controlled by the pilot, and could achieve a maximum of 30 knots.

C. Type 2 KAITEN (Figure 11). By December 1944, two type 2 KAITEN (Figure 11) were ready for test. Having been built from the keel up as KAITEN and not adapted from a torpedo, much better characteristics were expected (Table II). They were tested on land, but were never sufficiently perfected to give them a water running test.

The Type 2 KAITEN was designed to use hydrogen peroxide, hydrogen hydrate, fuel, and cooling water to form the gases of combustion.

The main engine, designated Engine No. 6, was designed especially for this installation. A board composed of torpedo and marine engineering personnel met and laid down the general specifications for this engine. These specifications, being "3rd degree secret", were burned at the end of the war. However, R. NAGANO, the chief designer of Engine No. 6, recalled from memory the specifications as follows: two rows of four cylinders, each with its own crank; cylinder diameter, 185mm; stroke, 200mm; engine RPM, 1500; propeller RPM, 750; weight, 1500kg; engine to withstand 13 atmospheres of external pressure; diameter of enclosing circular shell for external water cooling of the engine, about 1500mm; combustion gas supplied the engine was to be at 25 atmospheres pressure and 400°C.

The diesel engine design section at KURE, under supervision of R. NAGANO, worked 18 hours a day for two weeks, during August 1944, and turned out the manufacturer's plans. By November 1944 the first models were set up for testing by steam. Some models used cast iron cylinders and some used bronze. The crank case was cast steel and the pan was welded steel. Slide piston valves supplied and exhausted the cylinders. Construction of the engine was light. The entire engine was immersed in cooling water. The combustion chamber (Figure 14) and the hydrogen peroxide spraying nozzle (Figure 15) are explained in Enclosure (A).

The first external pressure test of 13 atmospheres deformed the crank case and pan, necessitating reinforcement.

The first load test was made on 20 atmospheres steam pressure, 300°C, with no back pressure because the hollow propeller shaft exhaust was not fitted. The engine developed 1500hp. The cast iron cylinders showed wear, but the bronze cylinders deformed and seized. Later the actual gas test was made with the exhaust connected to the hollow propeller shaft. It was never possible to get the back pressure down to 2 to 3 atmospheres. The lowest value of back pressure of 7 to 8 atmospheres, combined with 25 atmospheres pressure, the highest combustion chamber pressure found feasible, produced an acceptable compromise of 1000hp. But the combustion gas flow was never steady and leaks developed in the tin-lined hydrogen peroxide tank and lines.

The engine was so designed that a single handle controlled its complete operation.

Upon successful completion of the steam test in November 1944, orders were let at five different places for mass production of this engine. When the contracts were cancelled in April 1945, after the discontinuance of the Type 4 KAITEN, about 200 units had been constructed.

The after propeller was driven by a single hollow propeller shaft, and a mitre gear attached to this shaft through a mitre gear box drove the counter rotating forward propeller.

The Type 2 KAITEN embodied several new design features not found in the Type 1. The electric gyro was not changed, but the "off course signal" from the gyro directional pilot was designed to actuate an air slide valve which transmitted the signal to an oil hydraulic system, which in turn actuated the vertical rudder. The steering air chamber was used only to actuate the slide valve, since it was feared that oil would get sluggish at low temperatures and be unsuitable for the pilot signal. The constantly running hydraulic oil pump was attached to the main engine shaft of the KAITEN.
The spring-actuated depth gear moved the horizontal rudder by means of a hydraulic system to which oil under pressure was supplied by the oil pump mentioned above. Oil pressure was used to raise and lower the periscope through a range of about 70cm.

The same Type 2 pistol inertia exploder (Figure 24) and electric fuse (Figure 25) that had been used on the Type 1 KAITEN were also used on the Type 2 model.

The Type 2 KAITEN was designed for a depth of 100 meters and actually withstood 60 meters when tested, after being converted to the Type 4 KAITEN. Reference to Table II will show that the Type 2 KAITEN was larger and more powerful than the Type 1 and was designed for much greater range and distance. Finally, after repeated unsuccessful attempts to eliminate "bugs", the Type 2 KAITEN was abandoned.

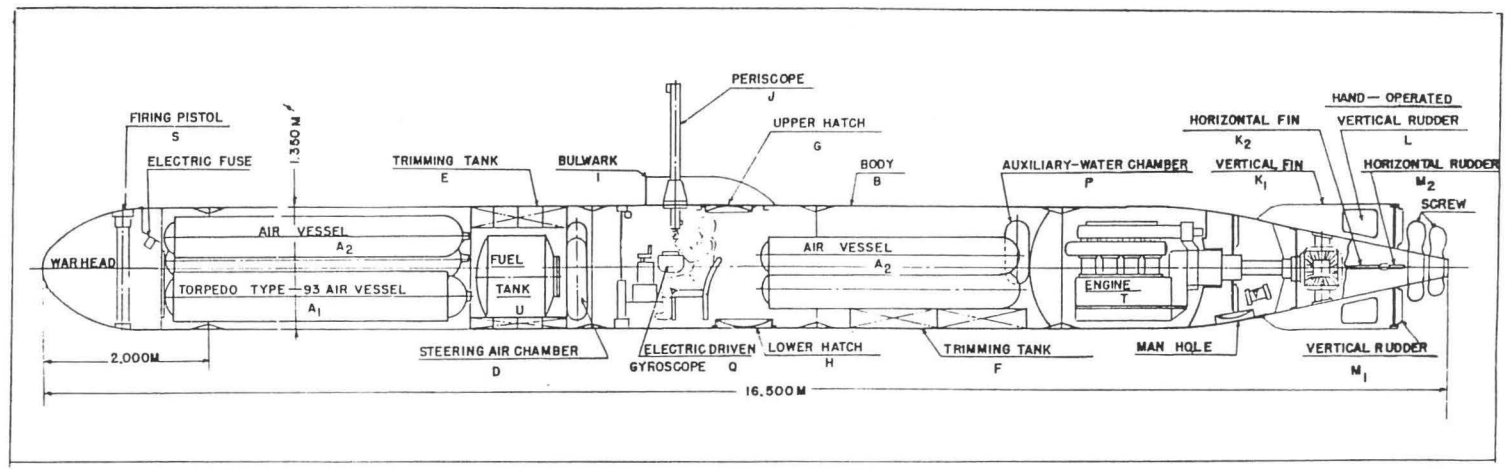


Figure 12

KAITEN TYPE 4

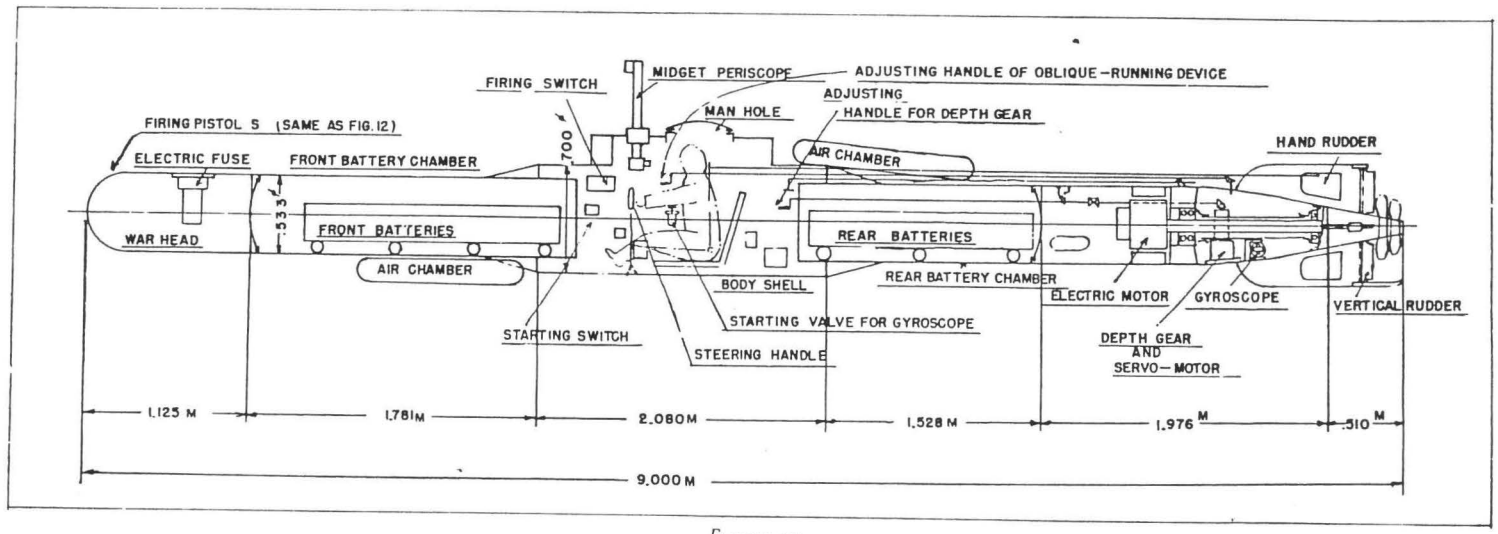


Figure 13

KAITEN TYPE 10

D. Type 4 KAITEN. Between January and March 1945 five Type 4 KAITEN (Figure 12) were tested and finally abandoned. The Type 4 design was developed in an effort to operate the Type 2 KAITEN on the kerosene and oxygen fuel successfully used in the Type 93, Mod. 3 torpedo. The main outer dimensions were retained, the same No. 6 engine and control equipment were used, but the fuel system was redesigned to utilize kerosene and oxygen in place of the hydrogen-peroxide formerly used.

The reduction in the weight of fuel carried permitted the installation of an 1800kg warhead in place of the 1500kg one previously used, while still keeping the total weight of the Type 4 KAITEN 200kg less than that of the Type 2.

On land test the Type 4 developed 1200 hp, but in the water test made only 20 knots, whereas its specifications called for a maximum speed of 40 knots. Maintaining a steady flow of gases of combustion to engine No. 6, as well as reducing the back pressure, seemed to present difficulty.

The Japanese concluded that there were too many difficulties to be overcome in the Type 4 KAITEN to make further work upon this model worthwhile, in view of the fact that the Type 1 KAITEN was already in successful mass production.

E. Type 10 KAITEN. After abandoning the Type 2 and Type 4 KAITEN, the designers next turned to an electrically propelled KAITEN, the Type 10 (Figure 13). They may have been influenced by the consideration that sufficient storage batteries were available.

Table II shows the Type 10 KAITEN to be about one-third the size of the Type 1 and to have only 300kg of explosive. The design embodied a minimum amount of change from the Type 92 torpedo. The charge could be fired by an electric fuse installed in the cockpit or by the Type 2 inertia pistol which fired on impact. (Figure 24). A front battery compartment and a steering air chamber were installed aft of the warhead. The control room for the pilot was located aft of the forward battery chamber. It contained: a firing switch; engine starting switch for the constant-speed motor to drive the KAITEN at one speed of 7 knots; hand directional steering; a small periscope which was fixed vertically but which could rotate; and an air starting valve for the air-driven gyro (Figure 18) located in the after end of the KAITEN. The remainder of the after part of the KAITEN was similar to that of the Type 92 torpedo except for the addition of a steering air chamber, a hand rudder and the enlarging of the horizontal and vertical fins.

This KAITEN had an upper hatch but no lower hatch; hence, it was not possible for the pilot to enter the KAITEN from a mother-sub while the mother-sub was submerged.

When underway the Type 10 KAITEN ran at the depth set on the depth gear. The spring versus water pressure depth gear actuated the horizontal rudder by means of air pressure.

To use the periscope, the pilot would stop the engine, and the 50kg positive buoyancy would bring the KAITEN to the surface. The free floating waterline was approximately in the middle of the small conning tower.

The pilot could not read course degrees from his station. After the Type 10 KAITEN was started and headed in the right direction by eye observation through the periscope, the air gyro for automatic course control was started by a control handle in the pilot control room. This operation was quite similar to the course gyro being started when a torpedo is fired from a torpedo tube. If the pilot wanted to change the course on which the gyro had been started, his hand-operated vertical rudder was sufficient to overcome the small vertical rudder operated by the gyro.

TABLE II

SUMMARY OF KAITEN DATA, ALL TYPES

Type	Diameter (cm)	Total Length (mm)	Weight of Explosive Charge (kg)	Speed/Range (kt - m)	Total Weight (kg)	Reserve Buoyancy (kg)	Center of Gravity (mm)	Total Length of Warhead (mm)	Total Weight of Warhead (kg)	Air Chamber								Steering Air Chamber				Type of Main Engine			
										Volume of A-Liquid Chamber (lit)	Weight of A-Liquid (kg)	Weight of A-Liquid Chamber (kg)	Volume of B-Liquid Chamber (lit)	Weight of B-Liquid Chamber (kg)	Maximum Charging Pressure (kg/cm^2)	Volume (lit)	Weight of Charging Air (kg)	Weight of Air Chamber (kg)	Maximum Charging Pressure (kg/cm^2)	Volume (lit)	Volume of Fuel Chamber (lit)	Volume of Lubricating Oil (lit)	Volume of Water Chamber (lit)	Cylinder-Bore x Stroke (mm)	Revolutions of Main Shaft (RPM)	Shaft Horsepower (HP)
1	100	14,750	1,550	12/78,000 20/43,000 30/23,000	8,300	100	8,800	2,250	2,250						215	1,550	435	1,076	200	160	196	107	5.5	142 x 180	685	550
2	135	16,500	1,500	20/83,000 30/50,000 40/25,000	18,370	530	9,300	2,000	2,100	2,630	3,500	2,236	256	210					215	430	550	270	100	185 x 200	750	1,500
4	135	16,500	1,800	30/38,000 20/62,000 40/27,000	18,170	730	9,300	2,000	2,600						280	3,343	1,204	3,804	215	80	550	270	45	185 x 200	750	1,500
10*	70	9,000	300	7/3,500	3,000	50	5,014	1,125	375										200	91						7

*Number of cells: 112 (28x4); Voltage: 56V; Amperage: 120A; Motor RPM: 216; Propeller RPM: 136.

ENCLOSURE (A)

THE NEW ENERGY SOURCE
OF
THE TORPEDO
(Prepared by Lt. Comdr. R. NAGANO, IJN)

As a new energy source of the torpedo, hydrogen peroxide, producing oxygen gas, was investigated:

When a concentrated solution of hydrogen peroxide (H_2O_2 about 80%) is mixed with the concentrated hydrogen hydrate ($(NH_2)_2H_2O$ about 80%) about one-tenth in quantity, the temperature rises to nearly 1,000°C, and a great quantity of oxygen gas is produced. We intended to use this reaction in driving the engine. When we mixed these elements in the following ratio:

H_2O_2	:	$(NH_2)_2H_2O$	:	fuel	:	cooling water
10	:	1.0	:	1.5	:	12

we obtained a combustion gas which contained over 70% superheated steam. The rest was CO_2, CO, H_2, N_2, etc. at a temperature of about 500°-700°C. Hence, we could apply this reaction and drive the engine of the torpedo.

At first we applied it to Type 93 torpedo and obtained, as a result of the low-speed braking test on land, the following results:

Pressure in combustion chamber	20kg/cm^2
Shaft horsepower	220 hp
Liquid efficiency	$\frac{\text{shaft hp x running time}}{\text{consumption of } H_2O_2}$

At the time, the investigation of KAITEN Type 2 was very urgent. We continued our experiments with the main engine (designated Engine No. 6) for the Type 2 KAITEN. By the end of 1944 we obtained the following results:

Pressure in combustion chamber	20kg/cm^2
Shaft horsepower	1600 hp
Liquid efficiency	900 hp sec/kg

The final tests, i.e. running tests, were about to be made, but they were never carried out.

The type of combustion device which is shown in the appending figures (Figures 14 and 15) had good characteristics.

Independently, the investigation to use concentrated nitric acid and alcohol had commenced and the experiment on combustion was going on, but satisfactory results had not yet been obtained.

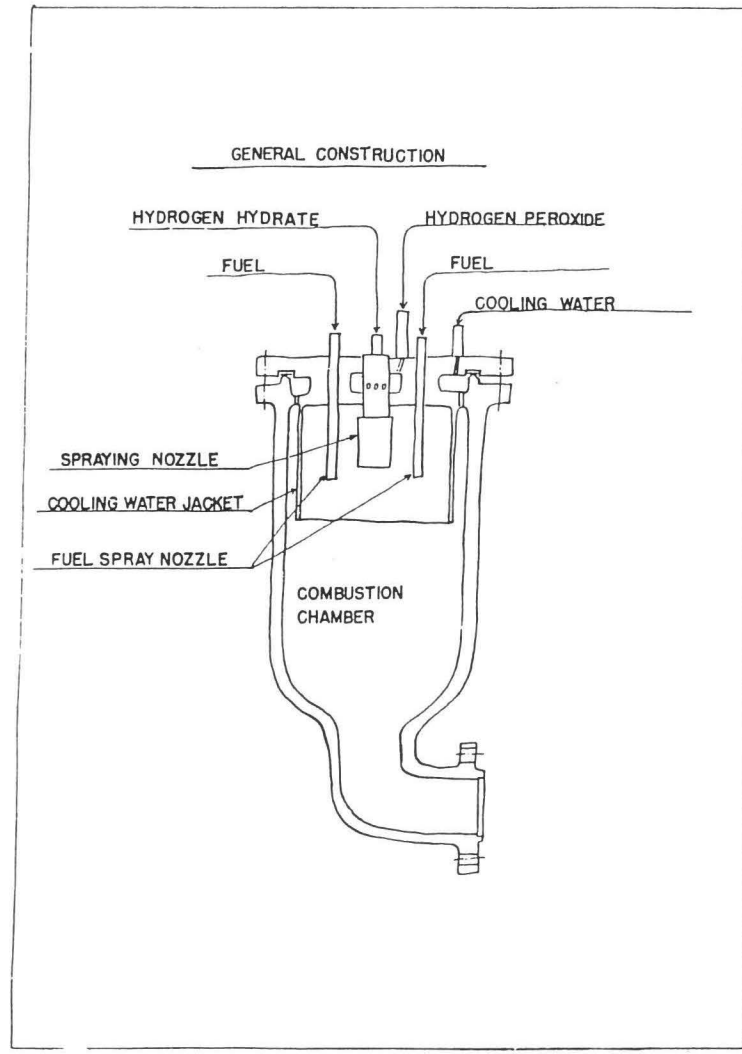


Figure 14

HYDROGEN PEROXIDE COMBUSTION CHAMBER

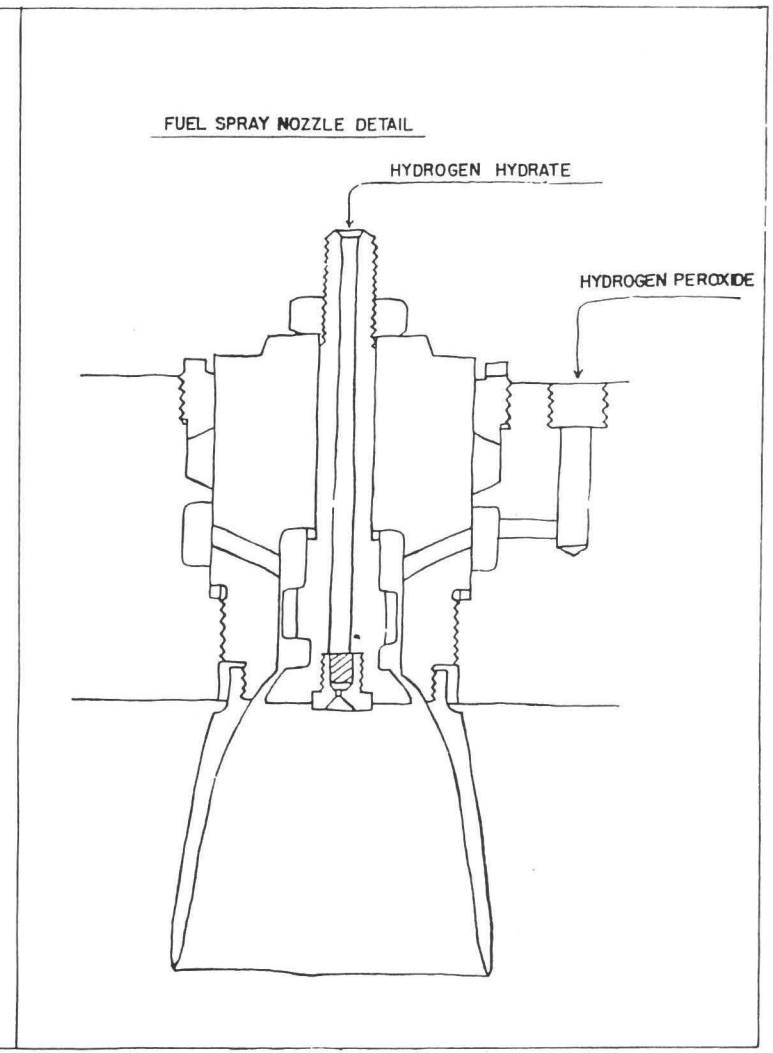


Figure 15

HYDROGEN PEROXIDE SPRAYING NOZZLE

ENCLOSURE (B)

STEERING APPARATUS
FOR TORPEDOES
(Applicable to KAITEN as Noted)
(Prepared under the supervision of Capt. K. MIMIZUKA, IJN)

[Note: KAITEN data only was not removed from this data because the remainder would be incomplete.]

The types of steering apparatus used in Japanese torpedoes were of the Whitehead torpedo type. The most typical one is the Type 4, Mod. 2 used for the Type 6 or 8 torpedo. As shown in Figure 16, the flywheel was driven by an air turbine and the air passage to the steering cylinder was controlled through a small slide valve which was regulated by an eccentric pin set on a vertical axis. The revolutional speed of the flywheel was about 15,000 RPM and it was maintained by means of an air jet.

With the advent of the oxygen torpedo, which had a very long range, a more powerful gyroscope was required and the Type 98 was developed. For this type, the flywheel was enlarged, the speed of revolution of the rotor raised to about 18,000 RPM, the accuracy of bearings was improved, and the direction maintaining capacity was greatly increased. Moreover, the adoption of a new type controlling valve which utilized the combination of a diaphragm slide valve and air-slit intercepting ring brought a satisfactory result. The details of this system are illustrated in Figure 18. The separation of the reducing valve and the steering cylinder from the gyroscope body, and the use of the rubber spring minimized the disadvantageous influence of engine vibration upon the gyroscope. This type was effective for a period of one-half hour.

On the contrary, the Type 2 gyroscope was the most simple one, and was suitable for the Type 2 mother torpedo. The construction of this type was almost the same as the Type 91 for aerial torpedo service, except for the possession of the oblique-running mechanism and the air jet device. The principle features are shown in Figure 19.

The greatest improvement in recent years in the capacity was made in the development of the electric drive gyroscope. The rotor was driven at a speed of about 20,000 RPM by means of a three-phase A.C. device. Five minutes were required to attain maximum speed of rotation from starting. Delicate ball bearings, which had high grade accuracy, were used in all axes, especially the horizontal ones, instead of the cone-type needles used in the Type 98. Owing to the above-mentioned improvement, these gyroscopes had sufficient ability to maintain their axes in one direction for about 10 hours with little deflection. Due to the lack of quick starting, this gyroscope was not used for torpedoes, but for small underwater weapons such as KAITEN, etc., where it was useful as a compass. This type required a motor-generator, battery, etc., as accessories.

Further, the Type 93 torpedo was equipped with a special steering device which permitted the torpedo to take a circular course after the straight desired running. The outline of the mechanism is illustrated in Figure 21. As is clearly seen from the Figure, air was sent to the intercepting cylinder (E) by the action of a cam (C) at the end of the straight run. The plunger (H) of that cylinder intercepted the air passages at both ends of the steering cylinder. Only the air from the reducing valve passed through this cylinder, pushed the piston of the steering cylinder on one side, and the vertical rudder turned the torpedo in only one direction.

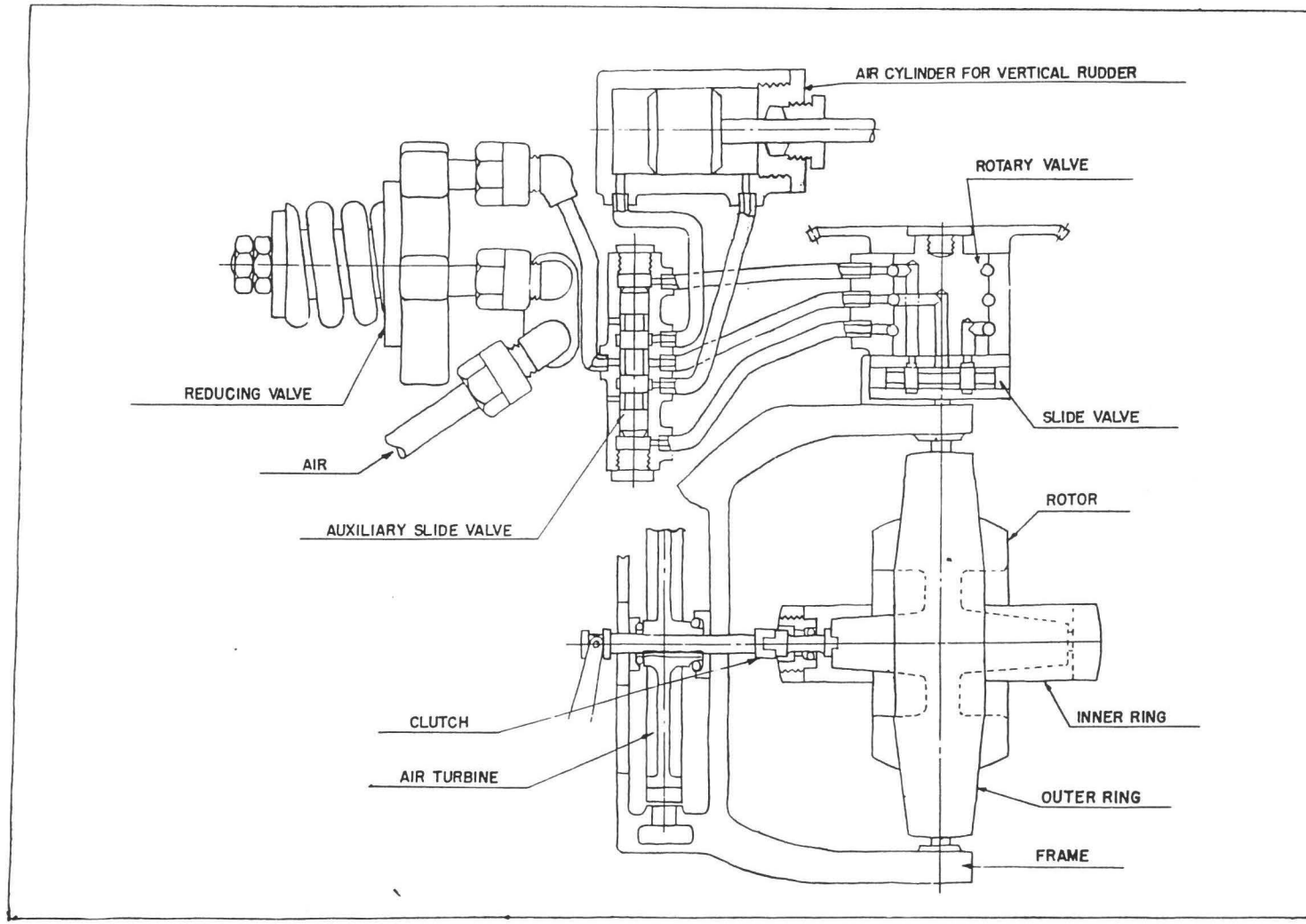


Figure 16

TORPEDO STEERING CONTROL, TYPE 4 MODEL 2

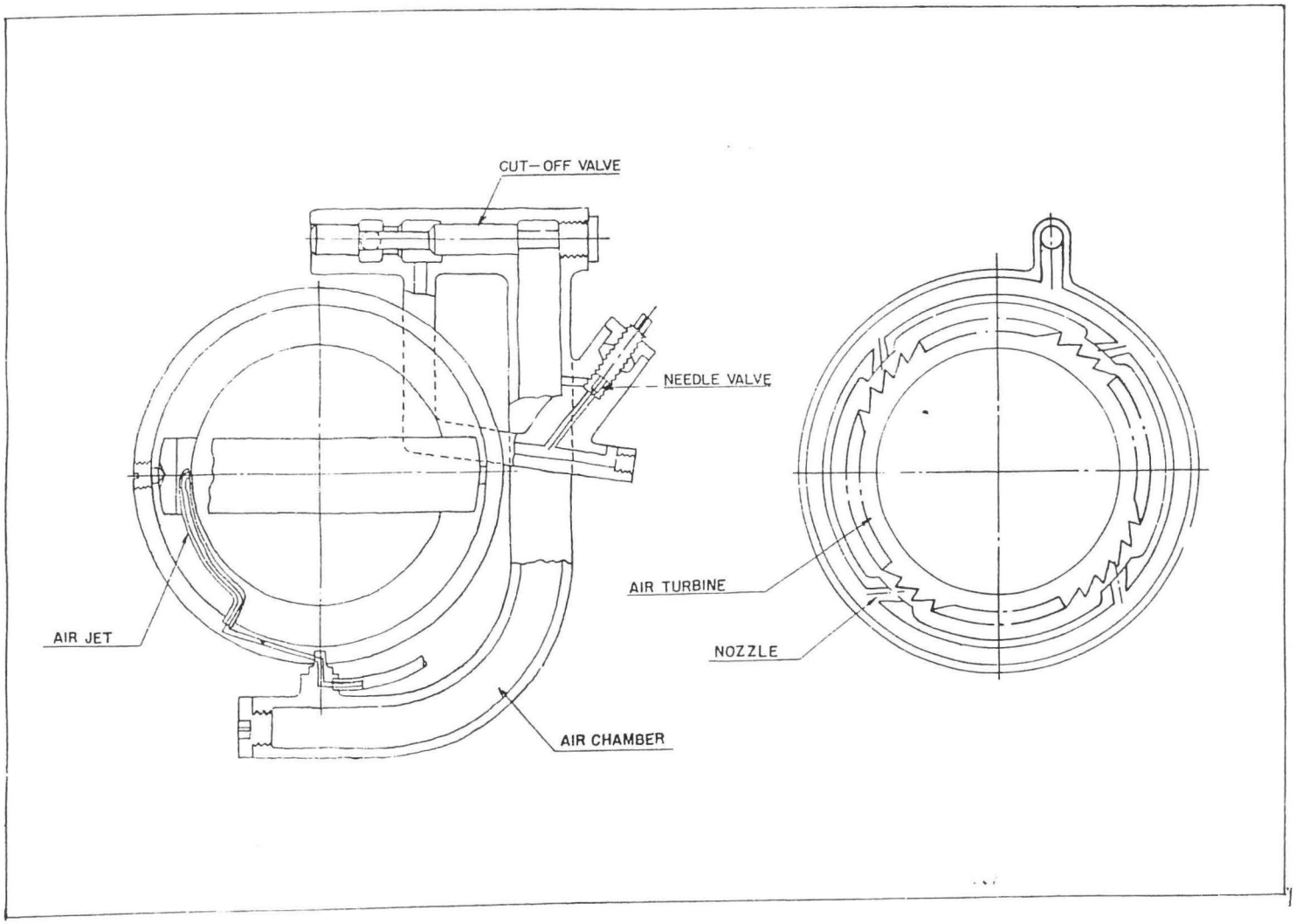
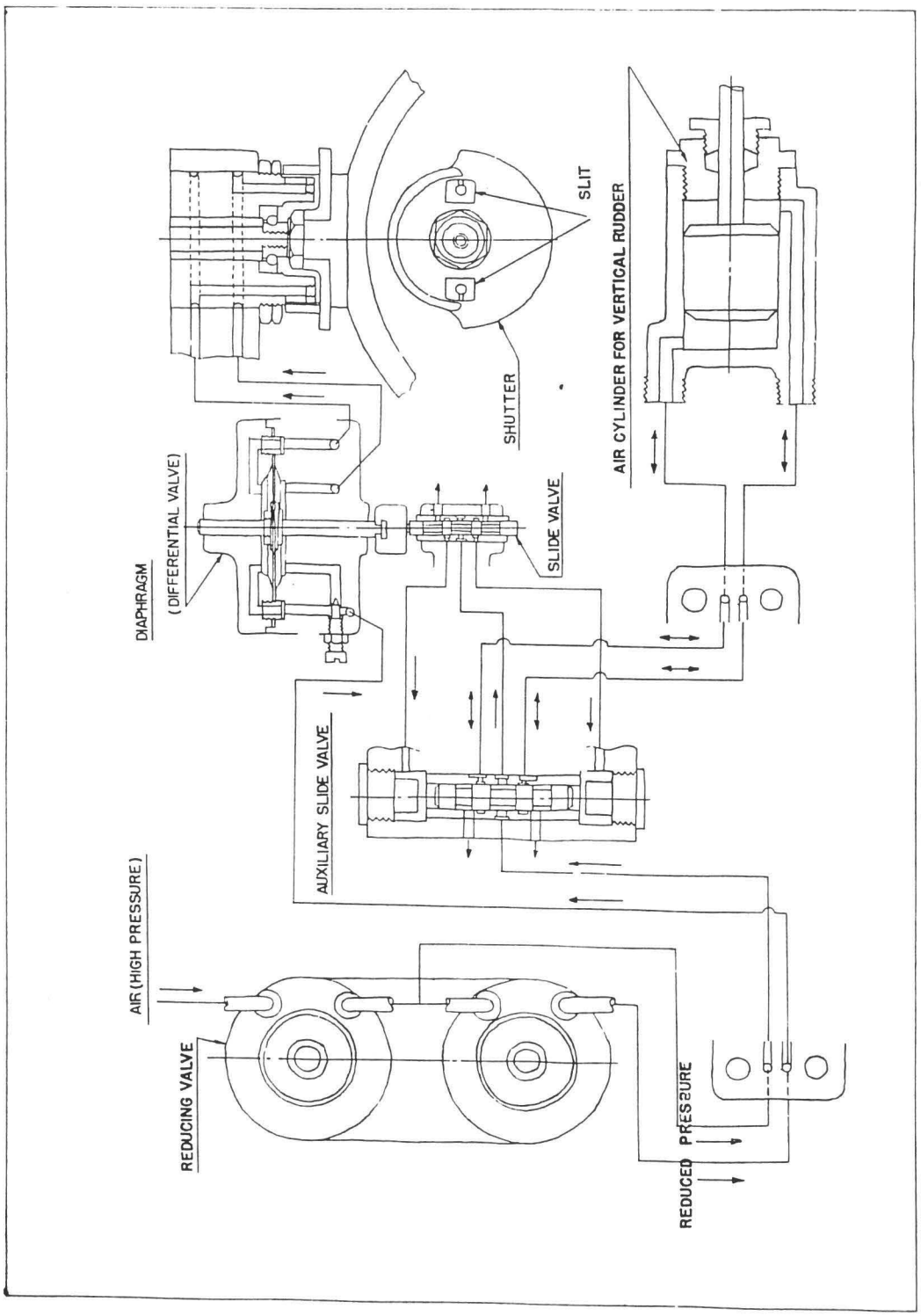
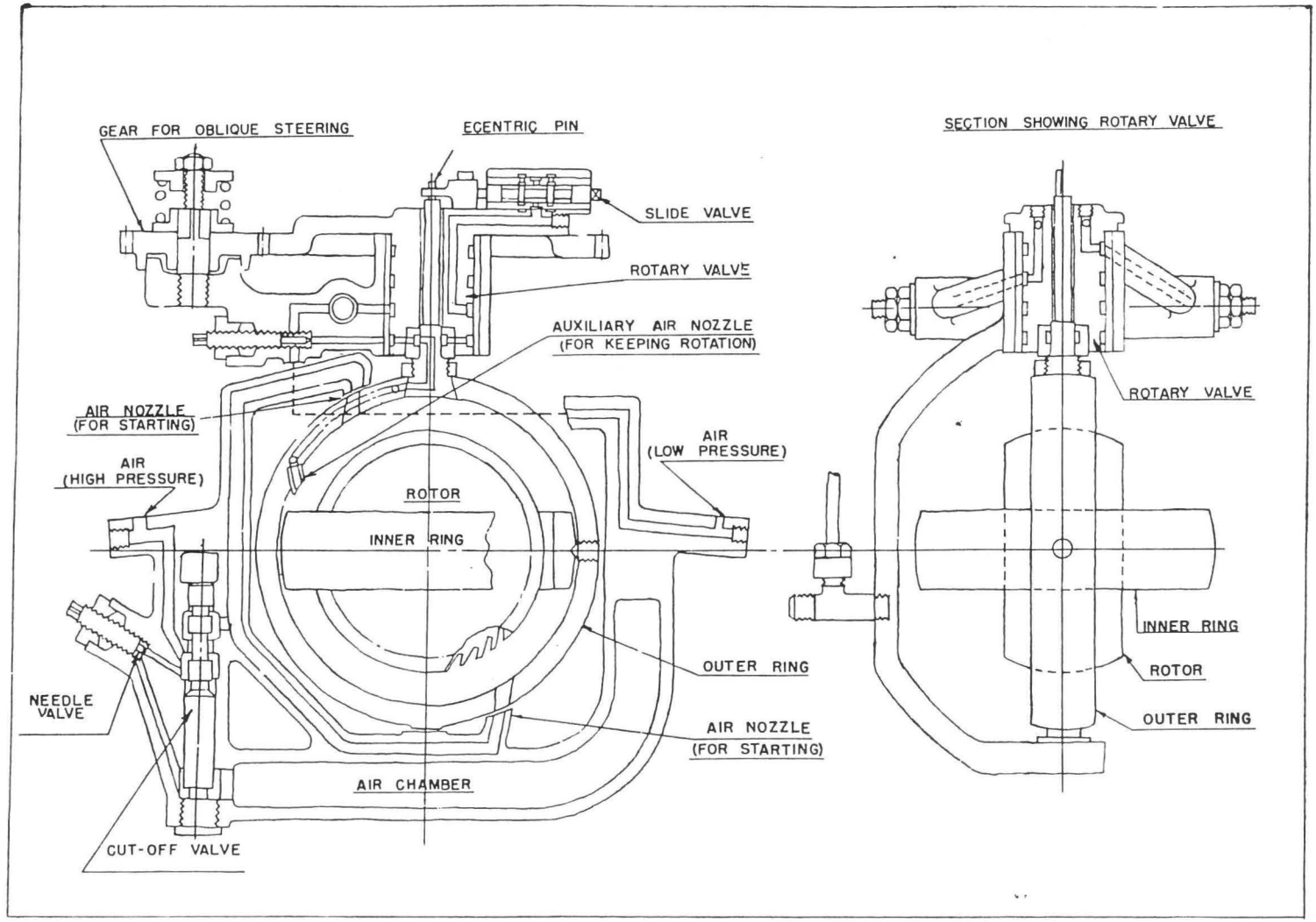


Figure 17

DETAIL OF GYROSCOPE, TYPE A, MODEL 2

ENCLOSURE (B), continued





ENCLOSURE (B), continued

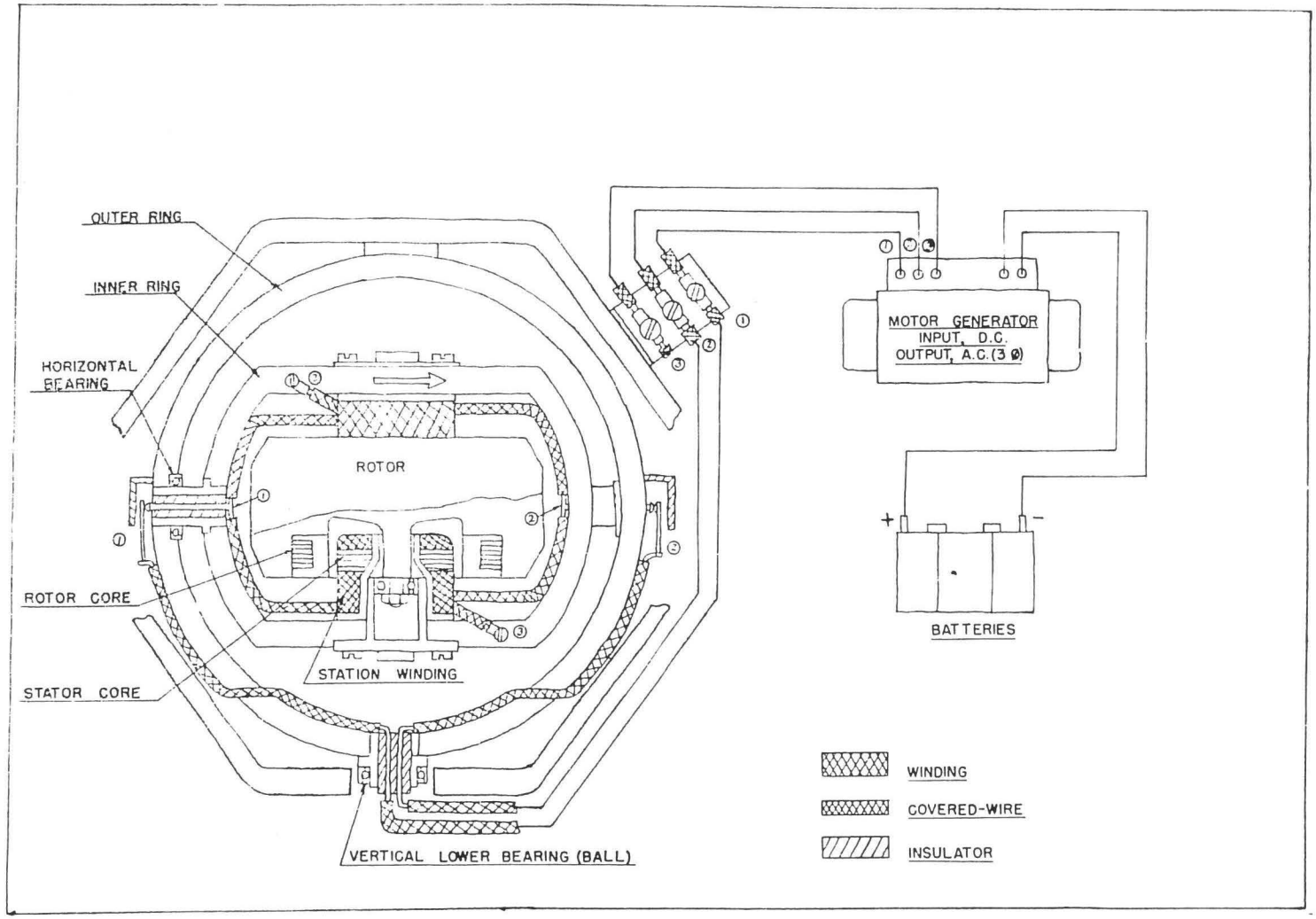


Figure 20

ELECTRICAL GYROSCOPE FOR TORPEDO STEERING CONTROL

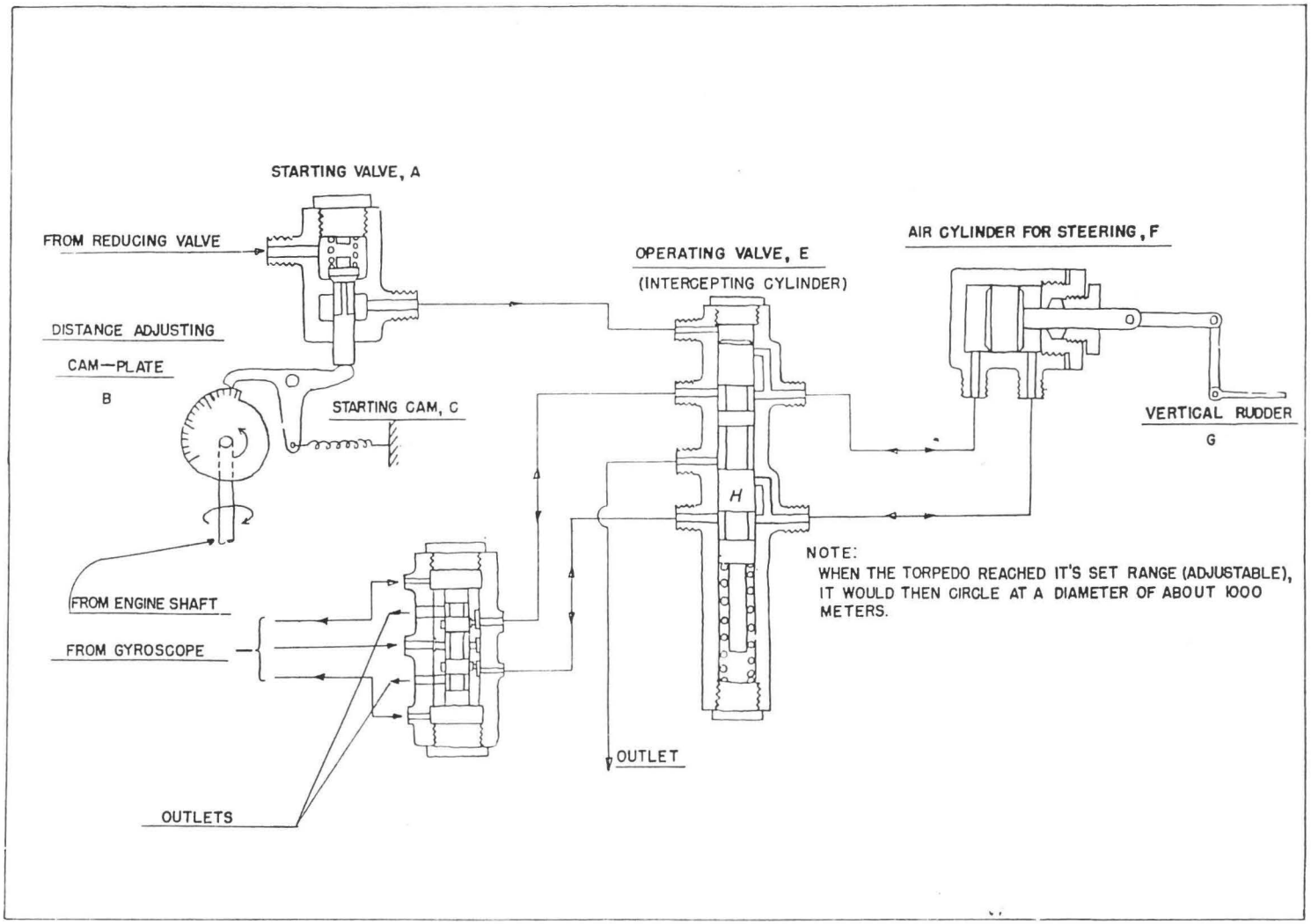


Figure 21

ARRANGEMENT OF SECONDARY STEERING DEVICE FOR CIRCLING

Type	Starting Method of Roter	Method of Roter Revolution	Diameter of Roter	Kind of Bearings		Type of Slide Valve	Max. Angle of Oblique Steering	Auxiliary Slide Valve	Location of Equipment		Type of Torpedo	Remarks
				Horizontal Axis	Vertical Axis				Reducer Valve	Air Cylinder for Vertical Rudder		
4 (Mod.2)	Turbine Wheel 4 Nozzles	Air Nozzle (through bottom of vertical axis	76mm	Cone-Type Needles	Upper Axis: Journal Lower Axis: Ball-Bearing	Slide Valve With Eccentric Pin	180° Both Right and Left Hand	Equipped	On the Gyroscope Body	On the Gyroscope Body	Type 6 Type 8 Type 89 Type 90	Standard Japanese Navy Type (See Figures 16 and 17).
98	Turbine Wheel 4 Nozzles	Air Nozzle (through bottom of vertical axis)	74mm	Cone-Type Needles	Upper Axis: Journal Lower Axis: Ball-Bearing	Slit-Type Valve With Diaphragm Slide Valve	180° Both Right and Left Hand	Equipped	On the Torpedo Shell	On the Gyroscope Body	Type 10* Type 92* Type 93 Type 95	Contained following improvements: Increased roter speed Increased roter diameter Improved type slide valve. (See Figure 18).
2	Self-Starting 2 Nozzles	Air Nozzle (through bottom of vertical axis)	74mm	Cone-Type Needles	Upper Axis: Journal Lower Axis: Ball-Bearing	Slide Valve With Eccentric Pin	180° Both Right and Left Hand	Equipped	On the Gyroscope Body	On the Gyroscope Body	Type 2	Almost the same construction as Type 91, for aeroplane service, but somewhat simplified for ship service. Has oblique steering device. (See Figure 19).
Electric	Electric Starting System (five minutes required for max.revolution)	Electric System		Ball-Bearing	Upper Axis: Journal Lower Axis: Ball-Bearing	Slit-Type Valve With Diaphragm Slide Valve	180° Both Right and Left Hand	Equipped	On the Torpedo Shell	On the Gyroscope Body	Type 1* Type 2* Type 4*	Capacity greatly improved. Roter system more powerful than Type 98. Horizontal axis had ball-bearings. Starting of roter was electric. Speed of roter increased by electric drive. Requires motor-generater, electric source, etc. No air jet. (See Figure 20).

*KAITEN

TABLE III

TABLE OF TORPEDO STEERING APPARATUS

ENCLOSURE (C)

EXPLODERS
FOR TORPEDOES
(Applicable To KAITEN as Noted)
(Prepared under the supervision of Capt. K. MIMIZUKA, IJN)

[Note: KAITEN data only was not removed from this data because the remainder would be incomplete.]

Torpedo exploders employed are shown in Table IV. Lever-type detonaters were used for the older type torpedoes such as Types 6 or 8. Construction was very simple, as shown in Figure 22 and the force of percussion was applied directly to the striking needle, and hit the percussion cup after shearing off the copper pin-stopper.

The safety mechanism was the fan-wheel (screwed out at the end of about 150 meter run), the "screw-out" mechanism of the striking needle, and the shearing pin, after the removal of the safety pin.

Inertia-type pistols, named Type 90, were installed in torpedoes in later years, e.g. Types 89, 90, etc. The principal features of construction are explained in Figure 23. The essential parts were the cup-shaped inertia body, the operating cylinder, and the stopping balls. When the torpedo hit the ship, the inertia body was tilted towards the direction of percussion and raised the operating cylinder by its skirt, being opposed in its movement by the stabilizing spring. When the cylinder was raised and the holes, bored in the lower part of the cylinder, come opposite the two stopping balls, the balls sprang out. Thus, the striking piece advanced owing to the force of the striking spring and the striking needle ignited the percussion cup. In addition to the normal safety devices described above, another one was provided for the contingency that a torpedo might "porpoise". A water-current resistance plate was fitted on the top of the pistol and it was pushed down by the force of water stream due to the underwater running of the torpedo. When the torpedo broke the water surface the water resistance disappeared, the plate stood up due to its spring force and pushed down the operating cylinder. Thus, the safety of the pistol is maintained when the torpedo breaks the water surface.

The latest torpedoes such as Type 93, 95, etc. were equipped with the inertia-type pistol, Type 2, which had almost the same structure as Type 90, except that a preventing device for sympathetic explosion was added instead of the safety device for breaking surface, and the design of various parts was refined. The device is illustrated in Figure 24. The essential parts were the hydraulic-pressure plate and the friction clutch. The stopping lever released the cylinder within 0.8 second by means of the fan-wheel rotation and the pistol was ready for the next phenomena. The safety device for breaking surface was removed because of its ineffectiveness.

Special detonating devices were the Type 1 and the Type 2. Their functions are briefly outlined in Table IV.

ENCLOSURE (C), continued

TABLE IV

TABLE OF TORPEDO EXPLODERS

Exploder	Form	Type of Torpedo	Remarks
Type 91 Mod 1	Operating Levers	Type 8	Three operating levers, striking-needle type, safety release distance 150 meters. (See Figure 22).
Type 91 Mod 2	Operating Levers	Type 6	Construction same as Type 91, Mod. 1. Operating levers were somewhat smaller. (See Figure 22).
Type 90	Inertia Body	Type 89 Type 90 Type 92	Cup-shaped inertia body, striking-needle type, safety releasing range 200 - 2,000m. Safety mechanism for breaking surface with a hydraulic pressure plate added. (See Figure 23).
Type 2	Inertia Body	Type 2 Type 93 Type 95	Almost the same as Type 90. Equipped with the preventing mechanism against sympathetic explosion. Safety mechanism for breaking surface eliminated. Safety releasing range 400 - 2,000 m (See Figure 24).
Special Detonating Device Type 1	Underwater kite	Type 92	Detonation under the bottom of enemy ship caused by the touch of underwater kite towed above the warhead. Safety releasing range about 400 meters.
Special Detonating Device Type 2	Electro-magnetic	Type 95	The change of the vertical component of terrestrial magnetism caused detonation beneath the bottom of enemy ship. Safety releasing range about 350 meters.

ENCLOSURE (C), continued

TABLE V

EXPLODERS, WAR-HEADS, AND GYROSCOPES FOR TORPEDOES

Type of Torpedo	Diameter of Torpedo	Type of Exploder (I) Inertia (L) Lever	Type of Warhead	Type of Gyroscope	Remarks
Type 2	45cm	Type 2 (I)	Regular Type 6(1)	Type 2	For use in midget submarines.
Type 6	53cm	Type 91, Mod. 2(L)	Regular	Type 4 Mod. 2	For use in older type of submarines.
Type 89	53cm	Type 90 (L)	Regular	Type 4 Mod. 2	For use in submarines.
Type 92	53cm	Type 90 (I) (2) Type 1 (Special Exp.)	Regular Type 4(3)	Type 98	Electric torpedo. For use in submarines.
Type 95 Mod.1&2	53cm	Type 2 (I) (4) Type 2 (Special Exp.)	Regular Type 5(5) Type 6	Type 98	Oxygen torpedo. For use in submarines.
Type 8	61cm	Type 91 Mod.1 (L)	Regular	Type 4 Mod. 2	For use in older types of destroyers and cruisers.
Type 90	61cm	Type 90 (I)	Regular	Type 4 Mod. 2	For use in destroyers.
Type 93 Mod.1&3	61cm	Type 2 (I)	Regular Type 6	Type 98(6)	Oxygen torpedo. For use in destroyers and cruisers.

NOTES:

(1) Type 6 is special V-head.
(2) Underwater-kite type special exploder.
(3) War-head equipped with exploder Type 1.
(4) Magnetic Type (induction coil) special exploder.
(5) War-head equipped with exploder Type 2.
(6) The steering system of type 93 was equipped with a special device which makes the torpedo turn around, after the desired running distance (Secondary steering device). Moreover, Type 93 has a special device which makes the torpedo run at a deeper depth compared with the ordinary depth (Secondary depth control device).

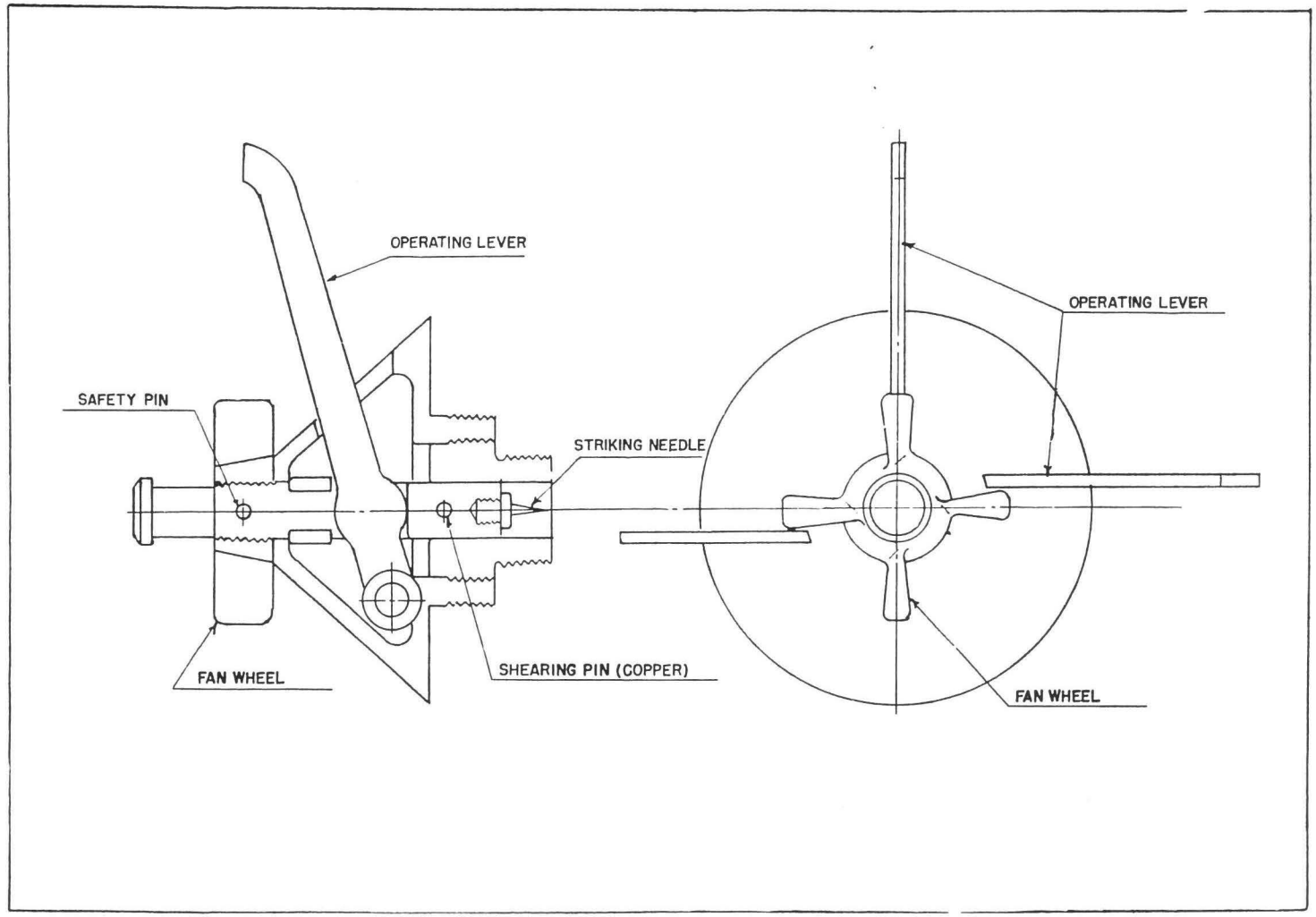


Figure 22
TORPEDO EXPLODER, LEVER TYPE PISTOL, TYPE 91, MODEL 1 OR 2

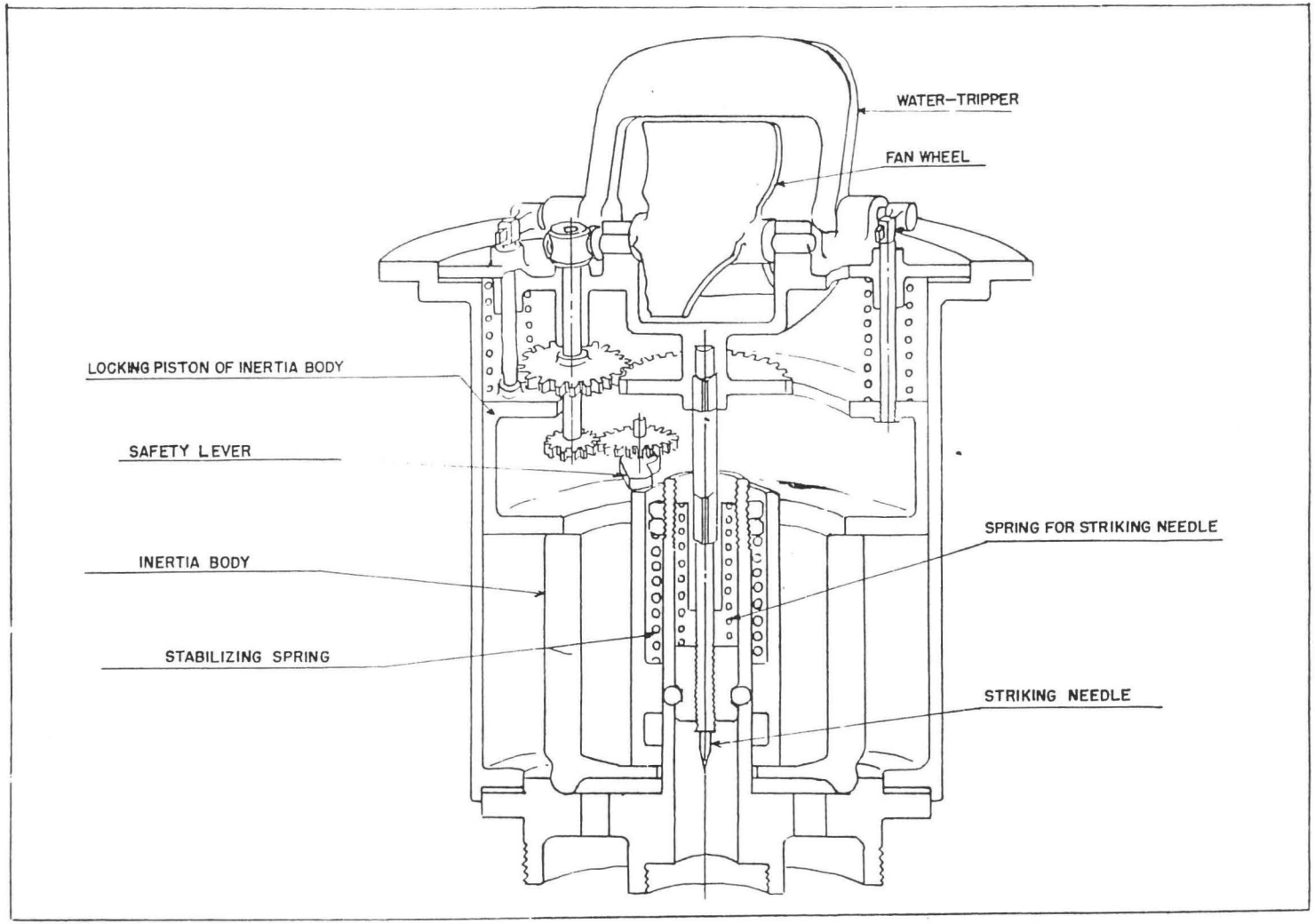


Figure 23

TORPEDO EXPLODER, INERTIA TYPE PISTOL, TYPE 90

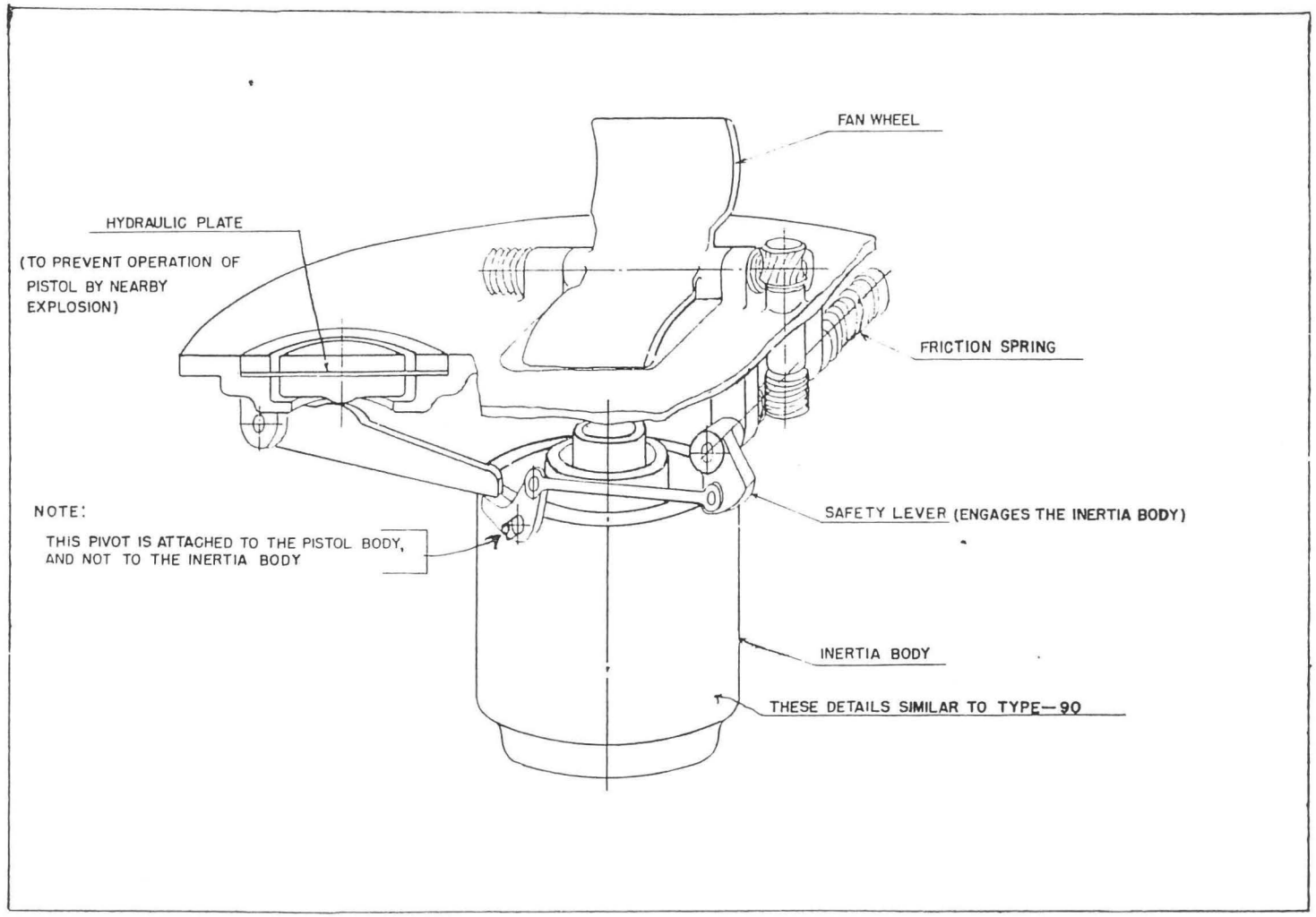


Figure 24

TORPEDO EXPLODER, INERTIA TYPE PISTOL, TYPE 2

ENCLOSURE (D)

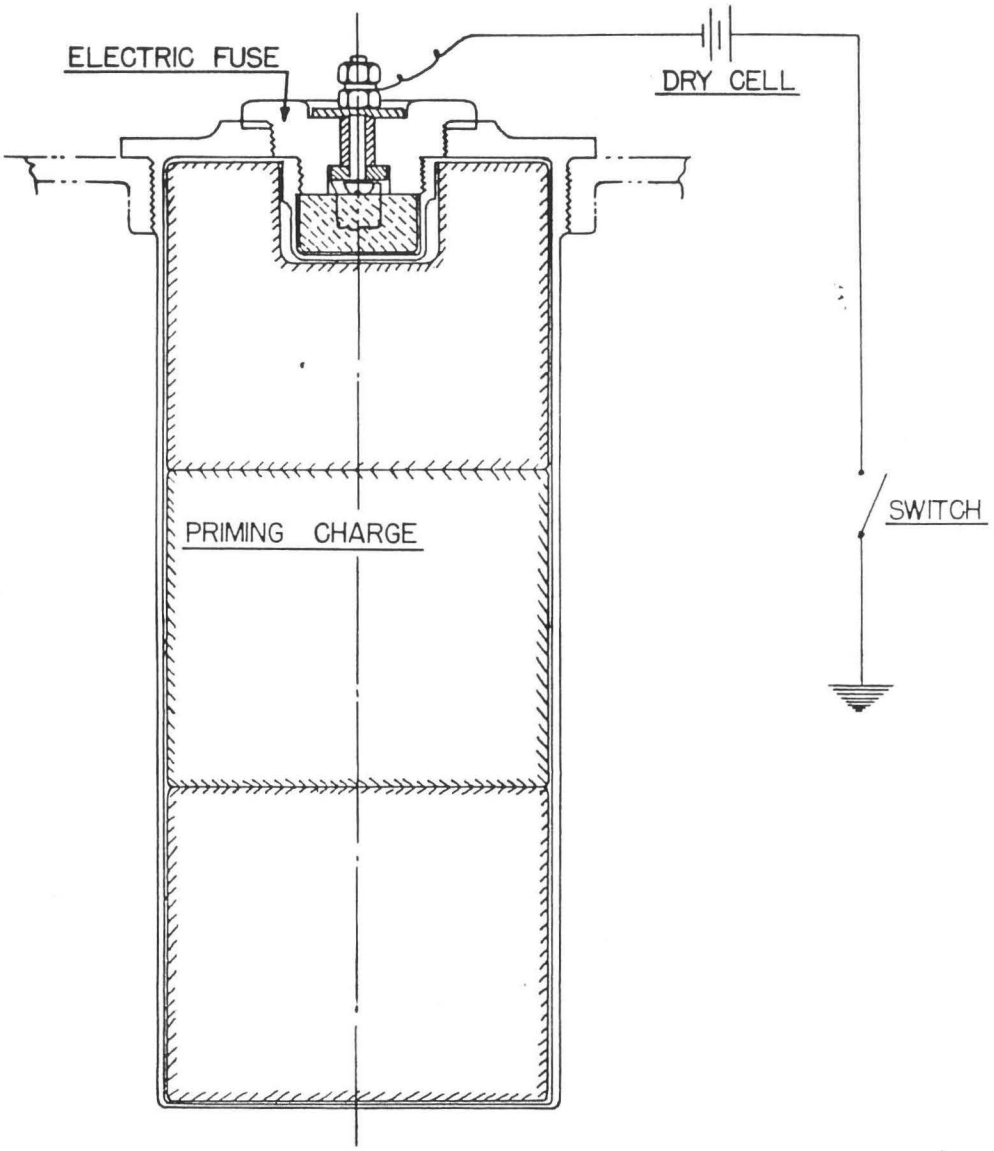


Figure 25
ELECTRIC EXPLODER NO. 9